PRELIMINARY EDITION

SCIENCE TODAY AND TOMORROW

TEACHERS' MANUAL

SCIENCE AROUND YOU

By GERALD S. CRAIG
and ETHELEEN DANIEL

CURRICULUM

GINN AND COMPANY

BOSTON · NEW YORK · CHICAGO · ATLANTA · DALLAS · COLUMBUS
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TEACHERS' MANUAL

for

SCIENCE AROUND YOU

By GERALD S. CRAIG

Professor of Natural Sciences, Teachers College,
Columbia University

and ETHELEEN DANIEL

Supervisor of Elementary Education,
Montgomery County, Maryland

GINN AND COMPANY

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This preliminary edition has been prepared as a special service to teachers who are using Science Around You. In the final edition some minor changes will be made and illustrations will be added.

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FOREWORD

SCIENCE TODAY AND TOMORROW

During the last twenty-five years, science has grown steadily in the elementary schools of the United States, Canada, and various countries of Europe, Asia, and Africa. This is no ordinary event, for new areas are not easily established in the elementary school owing to the tremendous pressure of various groups to gain the attention of children.

Science in the elementary school has to a large extent been developed by classroom teachers. They have experimented with new activities, new content, and new methods. Many of them have constructed curriculum materials and developed reading materials in science for the elementary school. As a result of this work, instruction in science in the elementary school is uniquely designed for use by classroom teachers.

The new elementary school program with its emphasis on science is a feasible program because it recognizes that the classroom teacher has many professional tasks; teaching science is but one of them. The teacher is a specialist in the education of children and not necessarily a specialist in science. There is no need for classroom teachers to feel any responsibility for specialized science tasks, such as naming all the objects in the environment, animate or inanimate, serving as a field naturalist, as a laboratory technician, or a general bureau of information.

It is evident that only those subjects that are in keeping with the basic purposes of the elementary school succeed in maintaining a permanent place in its curriculum. The American elementary school is a unique institution. It has been called at times "the great common school," in that it is the school for all the people. It was established by the early forefathers as the one institution that would be common to everyone, regardless of race, religion, economic status, and future occupation. It has become the basic institution dedicated to the task of the education of all people for citizenship in a democracy. A significant part of the success that science has had can be accounted for by the fact that elementary school workers have been concerned that science be developed in the interests of all boys and girls. This pattern for science in public elementary education is being adopted by a number of democratic countries.

SCIENCE FROM THE DEVELOPMENTAL POINT OF VIEW

Science in the education of children should be considered wholly from a developmental point of view. Recognition will then be given to the fact that children do not come to school for the first time at zero in science learning.

They have had a wide range of rich experiences with physical and biological phenomena. They may have a variety of experiences including those with friction, momentum, inertia, magnetism, static electricity, simple electric circuits, snow, ice, water, steam, melting, boiling, freezing, conditions necessary to certain living things, care of animals, seasonal change, the sun, the moon, stars, clouds, mirrors, magnifying glasses, evaporation, condensation, varieties of kinds of locomotion found in the animal world, animal mouths, ears, noses, coverings, balance with building blocks, wagons and tricycles, heat and cold, effects of seasonal change, different animal habitats in the community, solution of solids in liquids, molds, the large number of seeds produced by some plants, and so on. They may bring with them misconceptions and superstitions, or they may come to school with a good attitude conducive to learning and the development of intelligent and resourceful behavior.

Many teachers of children find it useful to accept a point of view of dynamic psychology for understanding children. Their ideas may be stated simply in such words as these: A child lives in a dynamic universe which is new to him. He is challenged by his many experiences. This universe is filled with a great variety of objects. He is impressed by the events (phenomena) small and large occurring about him, such as rusting, rain, weathering rocks, electrical shocks, thunder, wind, and falling objects. He finds himself in normal circumstances tremendously stimulated and turns naturally to exploring and learning.

A young child is naturally egocentric. He is not to be condemned for being so; his egocentricity grows out of his great potentialities for ceaseless drive and for adjustment and understanding of his environment and himself. As a result of the great drives and yearnings, he feels inside himself a whole gamut of emotions which are to him discoveries about himself. He may display grief, irritability, anger, restlessness, impatience, and disappointment. Although such expressions are not to be condoned or encouraged in children, they are not to be considered in themselves evil, for out of these emotional drives have come many of the great constructive developments of mankind, such as democracy, better living conditions, religious freedom, and improved health.

A child is an energy system and in all the universe we do not find its equal. It is remarkable that out of the use of his energy, a child is becoming intelligent in a universe filled with a vast variety of living and nonliving objects,

an almost kaleidoscopic array of events and changes. Within his rapidly widening universe, the child attempts to identify himself and his inheritance. Viewing children from this dynamic point of view assists parents and teachers to understand that the drives of children, which are so frequently annoying to the adult, are potentially constructive traits.

A child learns about his environment whether he is taught science or not, although some of his learning may be negative in value. The kind of science learning considered in this Manual begins in the cradle. As a child begins to separate himself from his environment, he begins to develop learnings based on these experiences. Parents and teacher must recognize that there may be learning about the environment even though a child is unable to state meanings in words. For instance, a child is experiencing something with the rattle he places in his mouth although he has no words with which to shape thought. He is learning something about the earth and its gravity as he pushes his weight against it in taking his first steps. Were the earth like a suspended rubber balloon that bounced away from him, or if the gravity were not constant and pulled him with greater force at some times than at others, he would develop a different set of attitudes and behavior. In considering science in the program of elementary education, it is well to conceive of science as beginning with birth. In a real sense, the adjustment to the environment can be traced back to the prenatal stages.

In a very real sense, we might say that the potentialities of science are inside human beings. To make it more personal we may think of these potentialities as being in such human beings as ourselves—teachers and children in the classroom. This is true because science has grown out of a tremendous urge on the part of mankind through the long centuries to come to an understanding of the universe.

Man, from the remote past, has sought explanations for the things that happen in the world about him. The rainbow, birth, death, life, lightning, and other events challenged him. He frequently used great ingenuity and much fancy to develop explanations for the phenomena about him. The myths and legends of many peoples indicate men have felt that if they could understand the world about them they might know more about themselves, their origins and history. The fact that primitive people frequently associated their explanations with their religious beliefs demonstrates how important such explanations were to them. In fact, these explanations had much to do with man's adjustment to the environment. Sometimes man's explanations made him fearful and superstitious; at other times they filled him with confidence, calm, and resourcefulness.

According to the developmental point of view, the origin of science is in man's distant past. An implication of this for teachers in the elementary

school is that science need not be thought of as something foreign to them or to the children they teach. Science as we know it today, with its discoveries and inventions, is the result of urges in men and women through the ages. We can see these same urges in children as they follow their natural drives and as they attempt to secure adjustment and equilibrium in a dynamic universe. They use the senses of smelling, tasting, feeling, seeing, and hearing, the kinesthetic sense, imagination, curiosity, energy, irritability, restlessness, play, response to external conditions, and other partly understood drives deep within their natures to project themselves into the areas of the environment. They depend upon impulse, fancy, creative activities, and logical thinking just as their ancestors did.

From the developmental point of view not all of science is difficult. On the contrary, from this point of view science is part of the earliest learnings of children. Furthermore, the technical, vocational, and specialized aspects of science have no function in elementary education. Elementary science is closely related to the experiences of children and to the kind of thinking they can do, so that teachers need have no fear of science. The teacher can learn the science that is needed while teaching science at any level in the elementary school.

The fear of science felt by some adults is not usually found in children. The adult may have been conditioned to a dislike of science in part by previous contacts with science instruction at high school and college levels, whereas children, having felt no such conditioning, are still following their natural impulses. Teachers can free themselves from their negative reactions if they will attempt to see the environment and science through the eyes of children. Encouraging children in a classroom to express themselves freely about their ideas of natural events has assisted many teachers to understand children and at the same time to gain a new look at the world for themselves.

USING SCIENCE IN A DEMOCRACY

There has grown up a conviction that the free nations must remain strong if they are to remain free. There is also a realization that there is power in science, and therefore that science is an essential element in maintaining and improving the democratic way of life. It will not be enough to have a small portion of the population educated as scientists; to be truly strong, an entire nation must be conversant with science. To realize this goal, science must be placed in the curriculum as one of the fundamentals. Making our whole nation conversant with science is a task uniquely suited to the elementary school since this is the institution of all the people. It is the institution which has in its enrollment not only the future scientists but the layman as well (and everyone is a layman outside his special field).

Strength for free peoples is secured through the development of good living conditions as well as military defense. Through the use of science man can do much to shape his own future, since science has tremendous potentialities for the improvement of living conditions for all.

The children now in our elementary schools will live in a world of tomorrow. Our boys and girls will live in a time of great decisions. They will need to make certain that science will be used for good and not for evil. They will need to determine how democracies can be kept secure. There will be great problems concerning the use of new and old sources of energy. Theirs will be the problems of wise utilization of natural resources, the distribution of new synthetics, medicines, and drugs, provision for health and well-being, development of materials from new sources, establishment and maintenance of research agencies dedicated to public welfare, the establishment of a balance of nature that will provide ample food and recreation for all, and the creation of a stable economy based on the natural resources and other problems to be solved, all within a democratic framework. Through all of this there will probably be a consideration of problems of international and world co-operation.

As we seek to determine what shall be the basis for our instruction in science in the education of children, we find we must look to something more permanent than a mere teaching about objects. We make this decision because in a few decades we ourselves have witnessed a vast array of new inventions displace objects which once seemed permanent. Kerosene lamps have given way to electric lights in many places. We have observed the transition from telegraph to television. Our familiar world is in constant transition. So, although we may utilize objects in teaching children, we cannot base our curriculum on objects. We must look deeper for our basic purposes.

Some might say that our major purpose is giving children content. But the content of science, important as it is in the education of children, does not constitute the fundamental purpose of including science in the elementary curriculum. This is true, first, because our basic purpose must be in terms of children and society, and consistent with the dedication of the public elementary schools to the principles of democracy. Second, as we shall see later in this introduction, we must recognize that the content of science is not absolute; what we think is reliable information today may need revision tomorrow.

What we can be certain of is that boys and girls will need to be resourceful and democratic in the decades ahead if their and our way of life is to survive. Therefore, we are concerned with the development of resourceful and democratic behavior. If we succeed, we shall not need to be unduly concerned for the future, for with the development of resourceful behavior in accordance with the high purposes of democracy, our boys and girls can use science to shape the future with complete confidence.

It is to be noted in this discussion that science is considered as a tool for humanity. There is no intent in the education of children to develop science for its own sake or to defend science as a vested interest. Only as science serves in the development of children and in the welfare of humanity can it be defended as essential in the education of elementary-school children.

It is most important that we recognize that boys and girls need to do much more than talk about science. If democracies are to preserve their way of life, there must be in their populations the ability to operate intelligently and resourcefully with the materials and energy of the universe to the best interest of mankind.

Social studies, however valuable they may be, are not sufficient in themselves to help children meet and solve the problems of today and tomorrow. Teachers and school systems are likely to miss the great contributions of science to children and through the children to the larger goals of democracy when they place science in the curriculum as a segment of the social studies. Science grows out of the tremendous urges of the human organism and does not have to be motivated through social studies. Many students of children think that science by its very nature is more challenging to young children than social studies. This is not to be interpreted as an argument against the social studies. It is, however, an appeal that curriculum workers thoroughly think through the concept that science is a part of the development of children. If properly guided, children can grow in intelligent and resourceful behavior just as they can grow physically if properly nourished.

Some have suggested that the primary purpose of science in the education of children is to develop "little scientists." Such an idea is not consistent with the fundamental purpose of the elementary school and the origin and nature of science in society. There should be no hero worship of scientists except in so far as an individual scientist deserves it. Democracy will be weakened if a society is created with a distinct scientific class. Scientists serve, but so do soldiers, senators, artists, carpenters, barbers, farmers, doctors, and everyone else. Scientists now and then outside their own special fields are somewhat naive, and at times exhibit traits of gullibility and dogmatism, thus violating the fundamentals of science. Scientists are human beings like other people. We should not set up the lives of scientists as ideals for children to follow, regardless of how much we may appreciate the contributions of science.

THE NATURE OF MODERN SCIENCE

In science we do not view knowledge as absolute. Any statement of science can be challenged, revised, or refuted with suitable data. There is no room for dogmatic attitudes. There can be no dictator for science.

Through science, man strives always for a better understanding of the world. Unfounded prejudices, opinions, gossip, rumor, astrology, myths, intuition, and superstition cannot be considered reliable sources.

Science is an active, dynamic field, constantly demanding willingness to make new observations, to repeat experiments, to consider new facts, and to challenge earlier conclusions. Science is far from a finished subject; in fact, it is likely that it is only in its beginnings. All the areas of science are undergoing changes as a result of continuous study. New ideas are being added and old ideas revised about stars, ventilation, living things, diseases, nutrition, and other areas of science.

Man learns through experiences by means of his senses. Science has produced new instruments, such as telescopes, microscopes, and others, that extend man's range of observations and experience. Nevertheless, to explain many happenings in nature, even everyday occurrences, is exceedingly difficult in spite of many new technical tools. So scientists have been forced to develop provisional explanations, or hypotheses, to guide them in further study of some things. But scientists must abandon any hypothesis as soon as it is found to be unsatisfactory. There is much that scientists have not satisfactorily explained. Many times a scientist must say he does not know even about problems within his own field of specialization, and even though he may by all rights be the world's leading authority on the problem involved.

Since man is continuously in the process of making new discoveries and revising his information, accuracy is not an exact status. This means that we do not teach a fact as though it must be true for all time. It indicates, also, that we cannot teach all the truth to a child about any single subject. We may, however, attempt to make certain in the classroom that the way in which a child learns is consistent with scientific attitudes.

We cannot hastily call an item correct or incorrect. Instead it is essential that in all our discussion, reading, experiments, and so on we determine what is the most reliable information at a given time. It may not be as serious a matter to be mistaken in the information we may have at any time, as to assume that there may be no need to secure new information on all important matters throughout our lives. It is also a serious matter to pass along information as if there were no question about its accuracy when we are not sure of its reliability. The nature of modern science is thus entirely consistent with the idea that learning takes place through the continuous growth and development of large concepts. It also indicates how necessary it is to view education as a process which takes place from the cradle to the grave.

Accuracy is a direction toward which man in his best efforts strives. It is also a goal toward which teachers and children can move in teaching and learning; it calls for growth for both teachers and children. A child's ideas

gained from science can be accurate in so far as they go, but as a child proceeds through the school, his knowledge about any one subject increases in amount and detail. In other words, we may not be able to teach children all the reliable information in science about a given subject, but what we do teach can be consistent with what is reliable. Authoritative books such as those in the Science for Today and Tomorrow series can be most useful to both children and teachers in maintaining a high standard of accuracy and sound development of attitudes.

SCIENCE AND BEHAVIOR

This condensed description of the nature of science has been provided because it has many implications for the teacher and can provide him with a sense of security and adequacy in teaching children. The teacher has the right according to science to play an honest role in the classroom. He has a right to admit that he is learning; that he makes mistakes sometimes; that sometimes a child with a special interest and concentration may be learning faster than he is. In a real sense, the scientific method is a method of honesty, and neither teacher nor child should be penalized in any way for being honest. The learner should never be humiliated for the admission of ignorance. The implications of science for mental hygiene and human relations are profound.

It would be well for the teacher to consider the implications of science in the development of such behavior patterns as open-mindedness, critical-mindedness, and the avoidance of gullibility. There is no greater educational factor operating in the modern world than the attitudes that teachers and parents utilize while working and living with children.

In science it is important to state the source of one's comment in explaining a phenomenon, such as evaporation of water, hibernation of animals, erosion of soils, and so on. For instance, one might say, "I read an explanation in _____," or "It may be _____," or "My father said _____," or "On my way to school I saw _____," or "I think it might have been," or "I used my imagination," or "I have an idea," or "I think I am right," or "I can do an experiment to show _____." This is preferable to giving such information as if the statements were unquestioned facts. We have sometimes called this identifying the source of a comment. Teachers and children should develop the behavior pattern of identifying the source of a comment.

Both teachers and children have a right to use their imagination, to speculate, to repeat information as long as they distinguish between reliable and unreliable information. Such a behavior pattern is in the direction of assuming responsibility for one's own speech. It is quite different from the behavior of gossip, loose talk, and rumor spreading.

This type of development should not be allowed to harm the good human relationships of children. Frequently children use parents' opinions as reliable information. It would be well for the teacher to handle such comments in a manner that will in no way decrease the child's respect for his parents. In a sense, the attitude of the teacher may be that we are glad to have what the parent has said, and indicate that further development of the statement is given in authoritative books. Perhaps the comment might be "What do persons who spend their lives studying this kind of thing say?" Science instruction should be utilized to improve the human relationships of children, those of children with children, children with teachers, and children with parents.

It is obvious that the great behavior patterns growing out of science are not built in a finished manner in a day or a year or a decade. For instance, critical-mindedness and open-mindedness require time for development. Development of the patterns associated with resourceful, democratic behavior should be considered a continuous program throughout the elementary school.

There is considerable evidence that three great achievements of mankind —democracy, scientific method, and religious tolerance— developed contemporaneously and out of the same general struggles. An examination of these achievements will indicate that these three have much in common in basic meanings. In the opinion of many students, real science cannot exist outside a democracy.

THE CONTENT OF ELEMENTARY SCIENCE

Almost everyone is impressed with the extensive nature of science; it has indeed grown tremendously in scope. No one can learn all science in an entire lifetime. It is also obvious a teacher cannot teach it all. Only a very small portion of the total science will be taught to children, but that portion can be most important in the development of citizenship. The question of how much content of science is taught is not of nearly so great importance as is the question of what content of science is taught and how it is taught. With the world situation as it is today, it is most important that the content and procedures of science (suggested to teachers and children) in such a series as Science Today and Tomorrow be those designed for the preservation and advancement of democracy.

Because of the extensiveness of science, there has been a tendency to develop what might be called encyclopedic instruction. Under this method students have been required to learn wide areas of content. Comprehensive instruction has been developed about animate and inanimate objects and about topics in the environment with little sensitivity on the part of curriculum makers as to the value of the content to the teacher and children involved. In

the encyclopedic type of instruction the purposes of science in elementary education became lost in small content and busy work.

A traditional trend in nature study has been to make science instruction dependent upon an incident approach. If a child brings in an object, such as a rock, a feather, or a flower, or if he can relate an interesting experience, then there is instruction in this field about the object or incident. If there is no object or no incident, there is no science instruction in such classrooms. Science becomes incidental and accidental in the classrooms of teachers holding to this point of view.

But science is no incident in the lives of children. In fact, it is and probably will continue to be one of the most dominating and decisive factors in the lives of children. Schools developing science on an incidental basis will not provide boys and girls with the education they need for the great decisions they must make for themselves, their country, and the world.

This is not to say that incidents have no place in teaching-learning situations. Natural incidents can be used as experiences for concept-formation and for the development of understanding of phenomena. But science with its profound and challenging ideas has a great contribution to make to the formation of concepts and important ideas. If our democracy is to survive, we must make certain that the potentialities of science in our way of life will be developed. This instruction must not be incidental.

Since the best information scientists have at any one time will need to be revised in keeping with future discoveries, a content of science in the elementary school cannot be considered as set and fixed for even a few years. There are, however, certain patterns for the universe which seem to persist as profound descriptive principles for all time, in spite of revision and modification that follow new discoveries. These patterns are described in the following statements: The universe is very large. The earth is very old. Many changes are going on in the universe. Living things are interdependent and interrelated. Living things which are living today are the results of adaptations that have been made in the past. There is a great variety among living things. There is evidence of a tendency toward balance among the forces and living things. For the sake of brevity, we can speak of these principles as space, time, change, interrelationships, variety, adaptations, and balance.

These patterns seem to be guide lines for instruction through the elementary school. A child can continue to grow along the lines of these great principles or patterns. The experiences an individual has throughout life can enrich his understanding of these principles. Man must recognize these patterns if he is to adapt his civilization to this universe. A knowledge of these basic patterns is necessary to the understanding of the world's problems and life's experiences in our modern democratic world.

THE LARGE PATTERNS OF THE UNIVERSE AS GUIDE LINES FOR TEACHING-LEARNING

The Universe Is Very Large—Space

As man has studied the universe that surrounds the earth, he has become impressed by the immensity of space. The earth which he thought was very large and the center of everything is small compared with many other objects in the universe. This earth is one of several bodies which revolve about a star known as the sun. The sun is one of millions of stars which compose a vast galaxy of bodies which is called the Milky Way. Man has learned that there are many other galaxies within range of the modern telescope.

While a complete understanding of the immensity of space is undoubtedly beyond the mental capacities of any one individual, it can become a guiding factor in the interpretation of the experiences of children at all levels. The young child may begin his growth in the understanding of space as he begins to associate with himself the rooms in his home and the yard or immediate vicinity about his home. Later, he learns the location of the nursery school or kindergarten when he is taken there by adults or by school bus. Still later, he goes to school by himself and learns where the homes of his relatives and friends are in relation to his own home. As he travels to neighboring communities, his world becomes larger. He may be intrigued by the observation that the sun and moon seem to follow him as he moves about.

A child's early contact with this pattern may merely teach him that the earth is a very big place compared with his familiar neighborhood. He may become acquainted with the appearances of the day and night sky. Later, his learning will reveal that the earth is very small in comparison with the stars and space. About the same time he will also learn that the stars are suns which are very, very far away. In later years he increases his understanding of the vastness of space by learning about the extent of the solar systems, the Milky Way Galaxy, radio stars, cosmic rays, the galaxies, the light year, and so on.

Any adult who has read modern astronomy, has attended lectures in this field, visited an observatory or planetarium, or considered the possibilities of space travel knows that his conception of space is still further improved after childhood. There are new, challenging thoughts for all levels—the junior high school, senior high school, and college levels—and, for that matter, many new discoveries still to be made by the astronomer. Some comprehension of this conception is essential to an appreciation of the significance of science in its revolutionary effect on modern thought. It is important that children should be started properly along this path rather than allowed to absorb

inaccurate and unscientific ideas of the universe and astronomical bodies and to grow up with earth-centered conceptions in an age of modern science.

The Earth Is Very Old—Time

The conception of the great age of the earth and of the universe has come to mankind as a revolutionary idea. Not only has it profoundly influenced scientific understanding, but it has altered man's attitude toward his own place and function in the universe. It was natural for primitive man to think that the earth had been formed just a short time before the advent of his people. Much of this primitive belief came down into modern times and still controls thought in scattered areas. Children in their early years may learn that soil is made from rocks, and through activities, observations, and experiences discover that the process of soil formation took a long time. They may also learn something about the forces which operate upon the earth to produce changes; that it was a long time before the earth became a suitable place for plants and animals; and that many kinds of animals have lived on the earth and have become extinct. These ideas furnish him useful content in constructing his understanding of the great age of the earth.

Children may have a variety of interesting experiences with earth forces: for example, they may examine pavements broken by water freezing in winter; feel rocks softened by the action of weathering; observe erosion after a rainstorm; note how plants keep soil from eroding; examine different kinds of soil with a magnifying glass.

Time is something to be learned. Children must learn the concepts of yesterday, today, and tomorrow; the meaning of a second, a minute, an hour, a week, a month, a season, and a year; the sequence of seasons; the varied lengths of life of living things. A tree may be several hundred years old, and on the other hand, a mouse may live only a few months.

Time is relative to both children and adults. A half hour may be a long time waiting for a plane or train, but very short if we are playing. A year between birthdays can seem a long time, but it is short in terms of the centuries the Indians have lived in the Western Hemisphere. The teacher and the parent can greatly enlarge children's concept of time.

In later work children may learn something about what has happened to the earth, the causes of natural features in various localities, the long ages of prehistoric life, the struggle of life for existence, the forces operating on the earth, and some of the changes that have taken place on the surface of the earth. This comprehension of the great age of the earth is essential to an appreciation of the antiquity of man and of man's attempts to build social institutions for his own welfare. The goal is not the memorizing of a chronological

sequence of events, but rather an approach to the modern conception of time. These ideas reveal to man the importance of building his social and political structure with the thought that he may live on this planet for some time to come, provided he uses his intelligence to assure survival. These concepts are fundamental to building an understanding of what is intelligent utilization of natural and human resources. This understanding is necessary for man's planning for his own future.

This background to an appreciation of the modern concepts of time and change should tend to inhibit chauvinism; it should teach each pupil that all life existing on the earth today is the result of a long succession of living things—a development involving a vast number of individuals and extending back to the beginning of life on the earth.

The mountains, rivers, valleys, plains, seas, and other physical features that we think of in connection with a given nation and that often come to be revered by the people of that nation have not always been there as they are now. The surface of the earth has changed its appearance many times in the past and is constantly changing today.

As the result of a long series of experiments in the art of living, man has become a dominant force in nature, and we have a right to feel a pride in the achievement of all mankind. It must be emphasized in our instruction that this achievement is restricted to no one race or nationality.

Changes Occur Continuously in the Universe—Change

The conception of change permeates all fields of knowledge, and man must consider these changes if he is to operate intelligently with natural forces. Modern geology reveals that our physical environment does not remain constant, that the history of the earth is a story of change—change in climate, in topography, and in the succession of living things.

The conception of change is manifest not only in geological history but in living things, as, for example, the changes produced by birth, growth, age, and death. There are also changes produced by the biological principles of struggle for existence; and these cannot be ignored by man in his striving to adapt the world to his needs. Then there are the changes produced by energy and movement. Astronomical bodies are seen to have changed position and character through cycles of time. The scientist learns to look for change in his explanation of phenomena; the layman must expect change as a condition of everyday life; the student of social studies and the citizen must anticipate change in the political, social, and economic structure. Information concerning changes produced by physical and chemical phenomena developed in terms of children's own experiences can be introduced during early school years and continued through later levels.

Children see water disappear from a dish by evaporation. They pick up rocks which have weathered so much that the rock disintegrates into small pieces in their hands. They see the changes in the sky, in the weather, and in seasons.

Illustrations of change include such phenomena as rusting of iron, melting of ice, boiling of water, weathering of rocks, variations of weather and of seasons, and innovations produced by man's discoveries and inventions.

School windows should be utilized more fully for the study of the succession of changes due to weather, to the seasons, to the time of day, and man's activities in relation to these changes. Brief excursions around the school ground will provide varied experiences depending on the region. The children may see frozen, muddy, and dry soil; the growth of plants; and a variety of plant structure, such as roots, stem, flowers, and seeds. An outdoor thermometer may reveal temperature changes. Art work can be utilized in the study of changes.

A community of living things never remains in a strictly static condition. Children can observe the changes in a weed patch near the school, in the thicket, or in a garden. There is a continual shifting caused by weather, seasonal change, and just ordinary life and growth within the cycle of new life, maturing, and death. All around children are evidences of change.

There is no exception to the occurrences of change even when man is involved. Natural forces are always present and working in an environment. Perhaps man can never control the natural forces. Rather he must learn to work intelligently with these natural forces to bring about changes which are advantageous to his best interest.

In addition, there are the great changes brought about by man's inventions and man's discoveries. Of course, children are not so aware of the significance of these changes as adults. However, the school must prepare children to meet change, for the next generation may need to be prepared for even greater changes than that of the present generation of adults.

Man has lived through revolutionary changes in his social living because of the introduction of new forms of energy and of ways to utilize that energy. The discovery of fire, the introduction of animals to carry man's burdens, the steam engine, the electric generator, and the internal combustion engine greatly changed man's social and economic conditions. The utilization of atomic energy is bringing and will continue to bring tremendous changes. Children should gain a feeling of confidence in the fact that they are not the first of the human race to witness revolutionary changes in energy. Furthermore, it might be well for us to know how man's discoveries of new forms of energy have brought about great potential supplies of energy for everyone. The advances in the field of agriculture and soil culture may have significant impacts on the future course of world events.

Changes brought about in a community also may be significant. What did the country look like before the earliest settlers came in? What changes have been brought about by man?

There are less than a hundred natural elements which enter into combinations and form the multitude of substances about us. Chemists find that some of these elements combine in so many different ways that to date they have been able to make but a small proportion of all the possible combinations. Chemists are learning to build out of cheap sources substances which in their natural states have been very rare. They have also learned how to make new substances, such as new drugs, insecticides, medicines, plastics, synthetics, and so on. In this way, science contributes greatly to an improved health, finer recreation, and higher standard of living.

Life Is Adapted to the Environment—Adaptation

Adaptation is a pattern which permeates the entire realm of living things, for wherever there is life there is adaptation. This is a conception of great significance in the modern world. Indeed, man's problem today is to adapt his social, economic, and political structure to the conditions of the environment and his own needs. In the early grades children can learn something about the homes of some animals and their adaptation to life in various places. They can be introduced to the idea that animals' structures have become modified to fit their environment. Later they can learn how plants and animals, including man, are adapted to seasonal changes. The study of prehistoric life is a story of adaptation, and can be supplemented by a study of how animals are protected against their enemies, how animals take care of their young, and how plants continue to live on the earth. Man adapts himself through community life. The advantages and disadvantages of this form of adaptation, along with a study of solitary animals, may be considered on intermediate levels. As the child matures, the scope of his concept of adaptation is further broadened through a study of prehistoric modifications, of the weapons which animals use, and of the struggle for existence.

The conception of this pattern, like the conceptions previously outlined, may influence an individual at all levels of his development. It may modify the child's interpretation of simple observations of the effect of seasonal change on plants and animals. It may give substance to the youth's understanding of the structural variations of living things, and to his consideration of problems of public welfare. It may determine the adult's participation in politics and in public forums. The scientist finds much that remains to be discovered concerning adaptation. The significance of this conception in the social studies can scarcely be overemphasized.

Some of the more general facts involved in understanding the concept of adaptation are the relationships of living things to temperature, water, food, light, gravity, and certain gases found in the atmosphere; the effect of some of the limitations of these conditions upon life; the narrow range in these conditions on the earth as compared with those found in the universe as a whole; the adaptations imposed upon plants and animals that live under these conditions; the prolificness of life; and the interchange of energy and substance between plants and animals and between the physical environment and living things. Through experimentation, discussion, and reading, children learn that living organisms need light, oxygen, nitrogen, carbon dioxide, heat, water, and other conditions in order to exist and to produce young. When some of these things are scarce or too abundant, life may suffer.

The implication for international understanding is that man frequently is limited by the physical conditions of the environment to which he adjusts himself. Some people must live in inhospitable places, such as swamps, deserts, and arctic regions. These people must utilize the materials that are available for shelter, food, and clothing. It is not surprising, therefore, to find among the peoples of the earth a wide variety of customs. Many of these customs which seem foolish to others may be the results of the experiences of many generations in a given environment and may be necessary to the survival of that people.

International co-operation has become a necessary adjustment on the part of mankind if our culture is to survive.

In science studies in the elementary school, children have an opportunity to realize that man is only one of a multitude of living things, and that, like these other things, he has survived because he has made adjustments and adaptations to the environment.

The Variations of Living and Nonliving Things—Variety

On the earth there are wide varieties of climate, exhibiting differences in mean temperature, in the range of temperature, in the length of the growing season, in the amount of rainfall and its seasonal distribution, as well as differences in exposure, in slope, in drainage, in elevation, and in soil. These factors create many kinds of environments and require adaptations to these environments. All around us we see in nature a variety of forms, differences in structure, size, habits, and life histories of plants and animals. They range from the inframicroscopic organisms to the gigantic forms of the redwoods and whales. The life span of some living things is very short, while that of others covers several hundred years.

When we see how many different kinds of living things there are, it is not surprising to find that there are also so many different kinds of people. Man has wandered about the world for thousands of years, living in many habitats widely separated from each other. We should expect, therefore, to find different races, languages, and customs, but a concept that science may teach is their interdependence despite their differences.

No two living things are exactly alike, although they may be of the same species. We cannot, therefore, judge all people of any nation on the basis of one or two we may have known.

Variation is manifested in the physical world as well as in the biological. There are many systems of organization in the physical world—the atom, the element, the molecule, the compound, the substance, the planet, the solar system, the galaxy. There are many kinds of minerals, soils, and rocks. There are less than one hundred natural elements; there are thousands of different compounds. There is variety in the manifestations of energy. Man, too, tends to develop variety of forms in his inventions, discoveries, engineering, and arts.

Children should become acquainted with this theme by being introduced to the range and scope of certain obvious characteristics in the physical and biological aspects of nature. Instruction should be chiefly concerned with the theme rather than with mere identification of animate and inanimate objects.

Each child has two parents. Each parent brings to the child a diverse inherited background. When we consider that this means for each child four grandparents, eight great grandparents, and so on, the tremendous potentialities working for variation in the human race become apparent. When to this observation we add the fact that each child has a different environment, the tremendous variations found in children in any classroom are understandable. Every individual is a result of success through a long span of years in that each of his ancestors is the result of two parents reaching maturity in spite of sometimes hazardous conditions.

The concept of individuality, that each individual is unique and different from all other individuals, is a part of the larger pattern of variety. Williams,[1] a biochemist, has recommended that we should start teaching children in the kindergarten that they possess individuality. His recommendations merit serious consideration by elementary-school workers. They point to one way in which science can contribute to mental hygiene. Each individual has a right to be different. He should not be amazed to learn he is superior to some of his classmates in some ways and inferior to others in other abilities.

[1]Roger J. Williams, Free and Unequal: The Biological Basis of Individual Liberty (Austin: University of Texas Press, 1953), p. 177.

This pattern can be used to develop a feeling for the dignity of the individual, a feeling so important in a democracy.

Following are some of the aspects of variations that are illustrative of those found in the environment of children:

changes that take place in the out-of-doors

the many different kinds of animals

the variety of animal noses, eyes, tails, mouths, coverings, legs

the variety in prehistoric animals

the different ways in which animals move about

the differences in animal homes, such as those on the desert, in the arctic, in swamps, underground, in fresh water, on the seashore, in the ocean depths, in the forest, in the meadow, in trees

the variety in locomotion, food-getting, breathing, and protection of animals

different ways in which animals grow up

the many different kinds of plants, such as those that develop from spores, those that develop from seeds, those that are annuals, those that are biennials, those that are perennials

the animals that are social, and those that are solitary

the animals that are cold-blooded, and those that are warm-blooded

Interdependence of Living Things—Interrelationship

This is an illustration of a theme which is practically universal in character. We see the significance of interrelationships as an integrating theme in many of the forces operating on the earth; for example, in the description of astronomical bodies, weather, and other physical phenomena; in the interdependence and interrelation of living things to each other and, in turn, to their physical environment; in the causes of ill health; and in the relation of pests and parasites to economic loss in the agricultural world.

Space does not permit a full discussion of how the idea of interrelationships in physical and biological phenomena may be developed. In the early years children gain experiences which lead to an understanding that some plants and animals in the garden are harmful. In later work they learn the value of certain other plants and animals and what people are doing to protect them. Attention should be focused in later elementary school work on the problem of conservation and on preparing pupils for a more comprehensive study of the biological principles involved in the struggle for existence, in the balance of nature, and in the interdependence of life. Some of the relationships of scientific discoveries and inventions to man's progress and welfare should be considered. Man does not live to himself alone. He lives in a world of interdependencies and interrelationships. He is dependent upon earthworms

and plants for the fertility of the soil. He is dependent upon the birds to keep the insects in check. He needs snakes, owls, hawks, and other animals to keep rats and mice in check. Spiders serve to control the number of insects. An animal which seems rather insignificant to us may play an important role in the development of conditions suitable to man.

The interdependence and interrelationships of living things to other living things and of living things to the physical environment is basic to the understanding of social issues. Physical and biological forces do not recognize national borders. A wind blowing in one country may be due to world-wide atmospheric conditions and the pressure of air in regions within the borders of other nations. Animals do not necessarily stop at national borders unless those borders are natural barriers, and even then certain animals are known to cross many such barriers.

In science the earth must be considered commonly as an entity; a disturbance in the physical or biological world in one part of the earth may have significance to many other parts. In a community a fire in one section is the concern of the entire community. A disease or a pest in one section of the world may become the concern of all peoples. Nations, therefore, should learn to work together in an intelligent way for the welfare of all peoples of the earth.

The natural resources of a country, such as soil, oil, coal, gas, forests, and pastures, are the result of natural forces operating for millions of years. People have not created them, but they frequently waste them through carelessness and mismanagement. Man can waste in a generation or two what has been the result of titanic natural forces operating over long periods of time.

Man, if he is to remain civilized, must disturb the original balance of nature, for only savagery can exist where man does not attempt to make changes. It is man's task to use the natural processes and resources in such a way that he secures what he needs for a high standard of living without hazarding the welfare of future generations. Man need not return to savagery nor disregard natural resources; he now has science to use in planning for the years ahead. It is incumbent upon the public schools to develop a generation with ability to meet its problems, both personal and social, with intelligence, co-operation, and resourcefulness. This calls for an appreciation of the interdependence of living things, and of the interrelations of living things and the physical forces and materials.

Balance and Imbalance—The Interplay of Forces

As one observes the many events or phenomena in his environment, one is impressed by the dynamic flow of events and the energy involved in them. If one could be an observer over centuries, one would be aware of the titanic

forces in operation; but seen one day at a time over the short span of a human lifetime these forces often pass unrecognized. Some, such as evaporation, seem small, yet scattered over the face of the earth, evaporation is tremendous and results finally in rain, snow, dew, frost, weathering, erosion, floods, blizzards, and other events.

There seem to be tendencies toward equilibrium and balance in the operation of forces. In a normal atom it is thought the positive electrical charges balance the negative electrical charges. It is thought that a static electrical charge is the result of an imbalance in these electrical charges. The shock we feel or the lightning flash we see is the resulting establishment of equilibrium of these charges. Even the thunder can be thought of as a clap caused by air rushing in where the air was expanded by the heat of lightning.

We have already spoken about the balance of nature. Man has been ruthless at times with this balance and has experienced economic loss resulting from dust bowls, soil erosion, waste of resources, epidemics, plagues, and pests.

There are forces operating also in the structure of the earth. It is thought by some geologists that in maintaining balance these forces have caused the formation of mountains, continents, and oceans. We witness earthquakes and volcanic eruptions as a part of the balancing of the earth's structures.

It should be kept in mind that the sun is a great source of energy and that it shines on the earth all the time. It shines on the other side of the earth while we are having night. It shines, when it is cloudy, although there are clouds between us and the sun. The sun then is like a great solar engine which furnishes energy for green plants to grow and make food, for water to evaporate, and for the movements of air currents or wind and of ocean waves. The movements caused by the sun's energy are checked and modified by the earth's gravity, its rotation, and to some extent by friction. There is a tremendous interplay and interaction of the forces in the universe.

Wherever we look we witness the operation of forces and the many evidences of balance. We also have experience with the operation of natural forces in and on our own bodies and our own efforts to maintain balance and equilibrium. Many psychologists explain learning at all levels as a process of attempting to gain intellectual balance in the face of a new situation, a problem, or a challenge.

CONSERVATION AS A PATTERN FOR BEHAVIOR—DEVELOPING RESPONSIBILITY FOR OUR ENVIRONMENT

As children develop better understanding of the basic patterns of the universe, they also may acquire more intelligent behavior in reference to natural resources, including human resources.

Some courses of study help to establish undesirable kinds of behavior, as when children are encouraged to develop collections which in turn can rob the environment. Sometimes they are instructed to bring to school collections of leaves, twigs, flowers, rocks, minerals, and bird nests.

We need to develop in children a feeling of responsibility for the environment. Conservation, or intelligent use of natural resources, consists of a kind of behavior as well as a body of content. Before moving objects, animate or inanimate, out of the environment and into the classroom, there are many major considerations which the children may discuss. To whom does the object belong? Do I have the right to take it to school? Do I disturb the environment if I remove this object from it? Am I destroying the natural beauty of the environment by removing this? Is the study I am going to make of the object one which merits its removal from the environment? Should I plan to return the object to the environment as soon as the study is completed? Can this object be studied properly if it is removed from the environment? Can I care for it properly in the classroom? If it is alive, does it have a chance to live in the classroom? Am I prepared to give it the care it needs to survive? One should keep in mind that living things are usually found in an environment to which they are more or less well adapted.

DEVELOPING BEHAVIOR CONSISTENT WITH HEALTH, ECONOMY, AND SAFETY

Many schools are now integrating health entirely with science and the social studies. Science provides the necessary background for the teaching of health information and the development of good health habits; therefore, a program of science in terms of problems and meanings should offer opportunity for the integration of science and health.

The relation between science and economy has too long been neglected. Because of his own ignorance of the operation of biological and physical principles, man is at present beset by a host of problems concerning international economy. Recent projects in a number of countries are helping to solve these economic problems in local environments by re-establishing in the natural forces a balance in favor of man's interests and welfare.

The relation of science to the economic problems of man is well exemplified in his struggle with pests. Man has carelessly introduced exotic plants and animals into almost all regions of the world. Many of these transplanted plants and animals, unchecked by their natural enemies and competitors, have multiplied so rapidly that they have brought havoc to the economic life of the nation. Control comes not alone from the work of fact-finding public or private scientific agencies, but also from the intelligent co-operation of the entire

population. Much can be done to secure this intelligent co-operation through an integrated program of education in the public schools. Mankind cannot afford to have another generation ignorant of the elementary biological principles of nature.

Another similar problem is to find ways to prevent loss of soil through erosion. In almost any section of our country we can find examples of the terrific loss of natural resources resulting from the lack of soil conservation. Creating an awareness of this problem in order to bring about intelligent individual and community action concerning it is no small part of the science program in the elementary school.

Many species of our indigenous plants and animals have become extinct because of man's ruthlessness and ignorance. Still others are in danger of being destroyed. Man cannot continue to be ignorant of the web of life in which he is by nature involved. The elementary school, as the tool of the common people, should work toward developing a generation concerned with the wise utilization of natural beauty and resources.

We cannot fully anticipate the environment of the future. New inventions may eliminate present hazards and create new ones, making it impossible for us to develop a code of conduct in safety instruction which will be functional for an entire life span. It may be well for us, then, in safety instruction, to place more emphasis upon scientific principles which are basic to safe conduct. Children at all levels should be encouraged to enter into planning with the teacher for safety on all excursions, including the short excursion, even though it may be only to the edge of the school ground.

Consideration should be given to what one should do in case of fire or other disaster so that the behavior is automatic. Classroom teachers and parents can have a powerful influence over the destiny of whole regions and nations by developing in children a willingness and ability to base their conduct and behavior upon sound information. Safety education, as one aspect of the goals of conservation, can well be integrated into the development of responsibility for one's own behavior and for the environment.

A VARIETY OF PROCEDURES

The teacher should look to a variety of procedures in teaching science. It might be well to avoid dropping into routine methods. Discussion, instructional excursions, observations, experiments, reading, use of visual aids, group work, and planning all play a part in the teaching-learning situations in science education. The teacher should consider her own interests, tempo, and rhythm along with those of the children. It is important that the teacher be happy with the procedures. It is well for the teacher to be present as a

participant in all the procedures. He should be a learner, for good teaching in science involves learning.

If there is one term that can be used to specify the kind of instruction appropriate to all phases of science teaching in the elementary school, it is "developmental." In this case it is developmental from the point of view of children and teacher, both as learners. It means the instruction develops, using the experiences and knowledge children may have or that can be provided for them. It is developmental in that children may participate in the development of the planning for the use of experiences, experiments, discussion, and authentic materials to provide solutions to problems. The new learning is made acceptable to the children by the nature of its development in instruction. Children are given time to internalize new learning, integrating it with their experiences and ideas. It is important in this development to provide opportunity for an idea to be tossed about in the thinking of a group, to be tested through simple experimentation, if appropriate, or through observation, to be talked about at home, and to be checked against authoritative books.

In any consideration of teaching methods, the primary concern in elementary education is what kinds of boys and girls are being developed. All of us need to be cautious that our procedures do not become devices and ends in themselves. Therefore, evaluation should be an integral part of instruction rather than something done at the end of a period of instruction.

At all times in teaching it is well for the teacher to know at what point the children are in a given development. In this Manual suggestions are given the teacher as to ways in which he can secure this information. It is well also to find out how the children think, that is, the type of thought structure they have. Such questions as "What do you think?" "Do you think so? Why?" "Why do you say that?" "How would you get the information?" "Do you think that is information we should accept?" will give the teacher evidence as to how children think and where they are in their development.

Regardless of how the instruction at any point is initiated, vital teaching recognizes the concepts children may have on a subject or problem. So it is well for the teacher to provide opportunity for them to express their ideas, however incomplete or inaccurate, in order that misconceptions may be brought into the open. It is most important that they be allowed to express themselves without the fear of censure or ridicule, although at times there can be the enjoyment of childish humor and fun without personal damage.

Very frequently children's concepts have originality and imagination. Their concepts also provide opportunities for evaluation of preceding work and reveal the kind of instruction needed for the clarification of ideas. The authors of this series have profound respect for the natural ideas developed by children.

Every child needs an adult who will sympathetically and intelligently listen to him. If such a person could be provided for more children, we would need fewer corrective institutions.

STUDYING CHILDREN WHILE TEACHING SCIENCE

Teachers will find their teaching enriched if they will study children as they teach. Science with its challenging content and its rich contribution to the attitudes and behavior of both adults and children offers unique opportunities for the study of children.

The greatest concern in studying children is not how much information children have secured, important as that may be. Rather, the main emphasis should be on what kind of boys and girls we have. What kind of thinking do they do? What are their outlooks upon the world? Are these outlooks constructive and democratic? Do the children think for themselves? Are they developing good ways of thinking? Are they learning to be resourceful?

At all times teachers should be alert to the kinds of behavior changes that children are making. The teacher may ask: "Are the children developing dogmatic attitudes, or are they willing to consider new ideas? Are they tending to accept every idea they hear without hesitation? Do they look for further evidence before drawing conclusions? Are they learning to use authoritative books? Do they report on out-of-school experiences in a wholesome way? Do they propose explanations? Are they learning to plan? Will they work with others?"

In this kind of study it must be recognized that behavior may reflect the home and the general background of the children. A dogmatic parent may cause a child to be gullible.

It should be kept in mind that it is the behavior in which a child has had some degree of freedom of choice which is the most useful for evaluation. The closely worded or directed question of the quiz program and the rigid recitation have little significance in evaluating behavior. In a sense it is the spontaneous behavior of children—the proposal of something to do, the inquiry, the choice of language in indicating open-mindedness, the critical-mindedness, poise, resourcefulness, the challenge of a statement, the willingness to consider new ideas and to take on new duties, the use of old learning in new situations and learning—which is useful in evaluation. All of this seems to favor a type of discussion in science instruction which allows for freedom of expression and thinking.

It is recognized in this that teachers need to study children as individuals and as groups and from a total, rounded-out point of view of education. The contention here is that science with its profound meanings offers unique

potentialities in studying children from this view. Children should not be evaluated as if the development in behavior relating to science were isolated from all other aspects of their lives. Science, as the interpretation of the environment, should be thought of as an intrinsic part of the life of children in the modern world, a part that may be an important factor in building desirable behavior.

A DYNAMIC EDUCATION FOR CHILDREN

The preservation and advancement of democracy depends to no small extent on the behavior patterns developed in children. We do not know what the future will be. In a sense we must educate children for uncertainty. This does not imply that we need be pessimistic about the problems these children will face in the future. Rather, we can be confident that if we assist them to develop democratic and resourceful behavior, they will make their own future.

It is the contention here that the outlook of children toward their environment and universe is the very core of the development of a resourceful adjustment to the future. While incidents play an important part in making learnings meaningful, science should not be incidental in the lives of children. Instruction limited to talking about science and a description of objects and events is not in keeping with the dynamic urges of children and will not serve to help them cope with the problems of today and tomorrow.

There is a need for a positive and dynamic program for children, one which develops a feeling on the part of children of being needed by our democracy, in times of peace as well as war. Children are needed not alone for their own nation but to assume responsibility for work toward a better world.

There may be opportunities for children and teacher to work to improve conditions in the classroom, in the school, on the school grounds, and in the community. In this way, they can see how science is used.

Science will continue to play an important role in the lives of our children. It is a powerful tool which can be used for good or evil, and children, the adults of the future, will have to decide which way it shall be used.

It is most important to the success of our way of life that children have a favorable attitude toward science. Science should not seem foreign or exotic to them. Science viewed as the result of the age-old drive of mankind to adjust himself to his environment and to maintain his own equilibrium in the welter of biological and physical forces carries with it a larger point of view than a purely vocational one. Science is the result of man's experience and logical thinking through the centuries. Science, like democracy or the mother tongue, belongs to all who wish to make use of it. Children should be made to feel that science belongs to everyone.

Science instruction should be a pleasant experience for both teachers and children. Teachers should feel relaxed with children while teaching it. Interest in science should be maintained at all levels. The instruction should be freed from busy work and the meaningless drudgery types of assignments. Exhaustive and overly specialized units should be avoided.

Boys and girls must learn to handle and to experiment intelligently with the forces and materials of the universe. Unintelligent tampering and carelessness bring disease, ugliness, waste of natural resources, unemployment, poverty, war, and widespread unhappiness. Children must develop a poised, well-balanced, yet realistic outlook upon the modern world. They must learn that by working resourcefully and intelligently they can create their own world.

Gerald S. Craig

PURPOSE AND PLAN OF SCIENCE AROUND YOU

WHAT SCIENCE AROUND YOU MEANS TO CHILDREN

Science Around You is the second-grade book in the series SCIENCE TODAY AND TOMORROW. The science experiences in this book are common to a majority of seven-year-old children everywhere. They make use of children's tendencies to touch, to see, to hear, to taste, to smell, and other natural drives of children in their attempts to orient themselves to their environment. These experiences can be utilized to help children to interpret their environment. Experiences suggested in this book have been developed according to the purposes of science in childhood education as presented in the Foreword of this Manual.

Science Around You offers a balance in many aspects of the child's environment. It is unique in its consideration of seasonal changes in several different regions. In the chapters on "Summer," "Autumn," "Winter," and "Spring," children will see that there are many changes in some places while there are few in others. These chapters are illustrative of a relatively warm region, such as the Gulf coast; the semiarid portions of Mexico, Canada, and the United States; and the temperate regions of the United States and Canada.

In other chapters children engage in firsthand experiences to see what is in the air and to learn how to interpret changing weather. They are given some simple and accurate explanations of earth and sky. They experiment with sound and find simple explanations of vibrations and how sounds help us.

Children are also helped to understand rough and smooth surfaces, sliding and rolling friction, and how friction helps us. They are introduced to concepts of energy and work. They observe that moving things do work and that things are moved by people, wind, water, springs, steam, gasoline, and electricity.

Science Around You also contributes to an understanding of things which need care, such as soil, animals, and machines on a farm. Children will discover that leaves, trees, and soil help to make good farm lands.

WHAT SCIENCE AROUND YOU MEANS TO THE TEACHER

The Manual supplies help for you in teaching science to second-grade children. No special science education is necessary to use Science Around You or the Teachers' Manual. You can use these books and learn with the

children as you teach. The authors suggest that you read the Foreword and this section of the Manual.

Teachers should have no hesitation in teaching science. It is the hope of the authors that every teacher will feel at ease with the children while using Science Around You. Science should be a pleasant experience for the children and the teacher. The teacher need not feel that she has to know answers to all the questions that children raise. It is no longer the teacher's function just to answer questions. The teaching of science in the modern sense is work and study with children. There will be times when a child, because of his experiences or family background, may know more than the teacher. The teacher need not feel chagrined at this. Rather she should capitalize on his experience, turn it to use in the classroom, occasionally help him to check it for accuracy, and develop richer meanings.

DEVELOPING SCIENCE CONCEPTS

Children face the task of acquiring concepts adequate for intelligent thinking and acting in our modern times. Wise teacher guidance helps them to face this task. Science Around You and the Teachers' Manual suggest many experiences that reveal the raw materials of sensory experiencing.

Children learn through the sensory experiences of feeling, hearing, seeing, tasting, and smelling. They experience friction, energy, and gravity in walking, running, jumping, and in moving objects. They have firsthand experiences with the changing seasons and weather. They see rust on objects. They see decayed materials. Children learn to manipulate mechanical objects and see how machines do work. They hear sounds and may be able to tell what is vibrating. They notice changes in the day and night sky. They sense time and space through their own activities and those of others around them.

As children acquire firsthand experiences, they see the common elements in them. They talk about experiences and attach words to them. They may read a printed page to get further meaning. With help they may express some of these experiences in written form. With more experiences the children make greater use of printed words, see more common elements and relationships, and make still larger generalizations. Such generalizations are their own conclusions stated in a childlike language. In this way concepts come into being as children mature and gain experience.

For example, a child plays in a sand pile at two or three. When he is older, he digs in the soil and finds small rocks, maybe an earthworm, tiny living plants, and other things. He notices many colors in soil. Still later he may rub rocks together, discovering that soil, in a large part, comes from

rocks and that it takes a long time to make soil. At about the second-grade level he may examine leaves, watch them turn brown, wrinkle, dry, break up, and decay. He attaches words to these experiences through speaking, listening, reading, or writing all along the way. From experience to experience he generalizes. He begins to generalize that many things and conditions are needed to make good soil.

As children use Science Around You, they will see the relationships between facts. As they see these relationships many times, they will tend to form science concepts appropriate to their level of maturity. Thus children can become more adequate in making interpretations of the environment around them rather than merely describing events. Their interpretations show that they can give reasons for what they say and do.

HELPING CHILDREN TO INTERPRET THEIR ENVIRONMENT

Much of children's interpretation of things around them comes from experience. Their interpretation of an experience is in a direction rather than in learning isolated bits of facts. On page 2 of this Manual you found a direction of interpretations at different age levels. Over a long period of time and through many experiences, for example, children come to understand something about the interrelationships of living things and soil and that it takes a long time to make rich soil.

On page 4 of Science Around You there is a variety of plants. Some of the plants grow in or near water while others grow under different conditions. You might look out your classroom window and see a great variety in living and nonliving things. You may see variety in rocks, soil, clouds, weather, machines, people, plants, or animals. There is variety in the kinds of plants and animals you see on a desert, in a schoolyard, on a hillside, in a valley, along a garden fence, in a pasture, or in a swamp. There is a great variation in our world.

In the chapters on "Autumn," "Winter," and "Spring," children will gain ideas about the ways in which animals are adapted to survive seasonal change. Some animals migrate while others hibernate during cold winter days. Plants are adapted to seasonal changes, thus enabling a species to survive. You probably will not need to use the word adaptation with children, but their interpretations of living things around them will reveal that they are moving in the direction of this larger pattern of our universe.

It has been said that: "The large patterns of the universe, such as space, time, energy, change, adaptation, interrelationships, variety, and balance are patterns of growth and development from the cradle through adulthood. These will never be mastered in our time and perhaps not in a thousand years by

scientists, but research indicates children can begin to adjust to the large patterns before they enter kindergarten. Man's success on the planet is dependent upon his ability to co-operate intelligently with the great forces and patterns of the universe."[1] These large patterns are discussed in the Foreword of this Manual.

The following pages of this Manual will give you clues about the direction children's experiences and interpretations may be moving in terms of larger patterns:

Variety

Observing Many Kinds of Plants, page 19
Observing Animals Outdoors, page 20
Seeing Many Seeds, page 33
Seeing Many Kinds of Clouds, page 48
Seeing Many Kinds of Nests, page 99
Digging in the Ground, page 106

Adaptation

Examining Leaf Buds, page 33
Discussing Winter Animals, page 77
Investigating Hibernation, page 78
Helping Birds, page 99
Discussing the Care of Young Animals, page 100
Examining Bulbs, page 102
Watching Insects That Make Changes, page 106

Balance

Using the Outdoors Wisely, page 32
Using a Park Wisely, page 103
Planting Young Trees, page 137
Seeing Some Value in Weeds, page 138

Change

Discussing Changes Made by Insects, page 35
Recording Changes in Weather, page 50
Discussing Changes in Water, page 50
Discussing Night and Day, page 60
Interpreting Winter Conditions, page 76
Seeing Changes in the Spring, page 97

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[1]Craig, Gerald S. "Index to the Future," Science for Today's Children, Thirty-Second Yearbook Number, p. 293. The Department of Elementary School Principals, National Education Association, Washington, D. C.

Listing Changes You See, page 98
Observing Changes Around School, page 101
Watching Changes in a City Park, page 102

Conditions Necessary for Life

Interpreting Sky Conditions, page 21
Discussing Dry, Hot Places, page 22
Watching a Butterfly Chrysalis Outdoors, page 36
Getting Water to Dry Places, page 103

Energy

Experimenting with Shadows, page 61
Experimenting with Sounds, page 86
Discovering Vibrations, page 89
Moving a Heavy Box, page 112
Experimenting with Rollers, page 113
Making Use of Friction, page 114

Interrelationships

Observing Smoke in the Air, page 45
Testing Facts by Experimenting, page 48
Seeing Different Habitats, page 100
Preventing Soil from Washing Away, page 101
Making a Garden and Watching Changes, page 105

Space and Time

Using a Globe, page 22
Looking Far Away, page 57
Interpreting Distance, page 57
Estimating Time and Distance, page 58
Testing Distance and Size, page 68

HELPING CHILDREN TO THINK

Sometimes the behavior of children is impulsive. Sometimes they give quick opinions, make snap judgments, and may act with little forethought. But this behavior is rather natural for children, and what they do and say should be respected by the adult. They should never feel penalized in science because of ignorance. Their misconceptions should be treated as an opportunity to help them think.

Co-operative planning can help children to become a little more reflective. It can help them learn to act more wisely. As you offer explanations and interpretations, you can help them to think more objectively.

If children are to mature and to learn how to think in a more objective way, they will need:

Help in sensing and stating problems or questions
(See examples in Manual, pages 19, 46, 60, 121, and others)

Encouragement in suggesting and stating hypotheses
(See examples in Manual, pages 33, 77, 87, 112, 122, and others)

Suggestions about ways of getting information, observing, experimenting, reading
(See examples in Manual, pages 19, 21, 34, 60, 77, 80, and others)

Guidance in making and checking conclusions
(See examples in Manual, pages 23, 35, 48, 61, 87, and others)

Young children may not use these procedures in a logical way, step by step, nor will they use them on all occasions. They can, however, use some elements of the scientific method as you guide their thinking and experiences along these lines. It has been said that: "The process (the scientific method) of getting the best statement of truth available should be a process that is made clear to children at an early age."[1]

USING THE TEACHERS' MANUAL FOR SCIENCE AROUND YOU

The purpose of the Teachers' Manual is to give suggestions for using Science Around You. You should use the Manual as much as you wish, modifying suggestions in the light of your knowledge of the children within your group and of the opportunities afforded by their own environment, by school policies, or by existing requirements.

For each chapter of Science Around You the Manual will use the following outline.

At the beginning of each chapter you find clues for understanding the behavior of children. This section will give you some clues for child study through their science experiences. It will suggest your role, as teacher, in helping children to become more adequate in interpreting their science experiences.

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[1]Craig, Gerald S. "The Development of Science in Elementary Schools," Teachers College Record, March, 1948, Vol. 49, No. 6. Columbia University, New York.

Science Meanings

In this section are listed the science meanings upon which to focus in order to develop the concepts in the chapter under consideration. Later, in a page by page development of each chapter of Science Around You, these meanings, as well as a few other related ones, occur as headings in the right-hand margin.

These statements, or meanings, of science concepts are not to be used directly with children. However, children may generalize or express their conclusions in a somewhat similar way and in their own childlike language. The science meanings will guide you in the development of the larger patterns or principles of change, adaptation, variety, energy, space, and interrelationships discussed in the Manual's Foreword.

Information for the Teacher

This section in the Manual will develop more facts than will be used with the children. It will put the science meanings, concepts to be developed with the children, into a larger context of explanations and interpretations for you. You will also find Science for the Elementary-School Teacher [1] helpful in extending your background of information. Other suggestions for further information are indicated in the bibliography at the end of each chapter.

Ways of Working with Children

Children may use Science Around You for different purposes. Among these purposes are the following: to find information, to solve problems or questions, as a guide to further study, or to help you begin a new piece of work. This section of the Manual will help you in using the text and illustrations, carrying on discussions, making observations, having experiments, recording, and evaluating.

Discussion. Children must have freedom in discussion for asking questions, stating problems, making explanations or hypotheses, stating reasons, and checking facts, opinions, and conclusions. The Manual for Science Around You will give suggestions on how to do this through such questions as:

How do we know this to be true?
How may we find out?
How may we test it?
How may we be sure?
How may we show that what we say is true?

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[1] Craig, Gerald S. Science for the Elementary-School Teacher. Ginn and Company, Boston, 1947.

Ample time should always be given for children to discuss their own firsthand experiences which are related to those in an illustration. Each illustration is an integral part of the text under consideration and will clarify and reinforce ideas. Effort should be made to help children to recognize and to interpret the science meanings being developed. Such discussions will reveal that they are getting a feeling for or moving in the direction of the larger patterns of adaptation, energy, balance, time, space, or interrelationships discussed in the Foreword.

Sometimes the illustrations offer suggestions for science experiences and show materials needed to try them in the classroom. Sometimes they suggest a place outdoors for you to visit for a similar firsthand experience.

The illustrations will afford opportunities for the children to discuss science ideas before reading the printed words. Encourage and listen to their spontaneous comments. The illustrations will help you to use the new science words naturally in conversation before reading. Thus these new science words will be in the child's speaking vocabulary before he reads them. Wise use of pictures helps to develop science concepts.

Children's spontaneous comments will be of great value to you. You will need to listen to their ideas. Through discussion and use of the illustration the children will reveal what they already know about a subject. This will give you clues as to what you may expect to build on. From time to time the group may actually list what they already know as you write their statements on the blackboard. Such a discussion could naturally lead to planning what the children wish to find out or do.

Children need to begin the art of participating in discussion. The ideas of children should always be respected. It is well to remember that good questions can be as valuable as statements of facts.

Discussions need to be guided and to have focus. The following topics in this Manual will show you pages on which you will find some examples of needs for discussion:

Stating a Problem, page 19
Stating Proposals or Hypotheses, page 33
Using Questions, page 35
Giving Explanations and Interpretations, page 47
Listening to Explanations, page 67
Challenging Thinking, page 89
Avoiding Gullibility, page 90
Reviewing and Using Facts, page 90

Experimenting. This Manual and Science Around You suggest many firsthand experiences and simple materials to test out ideas. Strictly speaking

most of these are not real experiments, but experiences where simple materials are used. Genuine experiments are carefully controlled. They are developed under certain known conditions. Thus the results of an experiment can be relied upon. Children "experiment" to solve a problem when they do not know the solution, but because conditions are not controlled, they may not find the right solution. However, many science experiences help children to investigate and to think more objectively.

The following topics in the Manual will show you pages on which you will find examples of experiences using simple materials and of ways you can help children to think more objectively:

Learning How to State Hypotheses or Questions, page 19
Experimenting Again to Check, page 46
Testing Facts by Experimenting, page 48
Experimenting to Clarify Ideas, page 60
Experimenting with Shadows, page 61
Reading to Check Experiments, page 61
Experimenting to Show Reasons, page 69
Checking Hypotheses by Experimenting, page 87

You can help children to think more objectively by encouraging them to check the results of their experimenting. One way to check is to do the experiment several times and see if you get the same results. Observing a situation more than once is another way to check conclusions. Whatever the experience is, help your children to check it in order to be sure that they have the best statement of truth possible.

Reading. Think of reading as reading and discussion. Try not to feel too hurried. Through discussion and use of the illustrations as previously described, you can encourage children to tell about their past experiences, use in the conversation new words known to be in the selection, or list questions or problems to be solved.

The science meanings listed for each chapter will help you to focus on the specific science concepts. These concepts should be in mind while you guide the discussions before reading.

You will want to help the children to have a pleasant and successful reading experience. Their reading should be guided by some purpose. It may be a question or a problem and preferably the children's. You should not hesitate to guide the reading with your own questions, however. At this time you should also give needed help with any words. Emphasis should be on getting the meaning of the ideas being developed in the selection. More specific suggestions for guiding the reading will be given in the page by page development.

It has been the authors' experience that children like to use science words. Many children like to use such science words as evaporate, vibrate, or hibernate. You should work toward the development of the concept of a word. All new words used in Science Around You are on pages 12-14 of this Manual.

Rereading is done with a new purpose or question to get fuller meaning. Rereading for a new purpose may be done to clarify differences of opinion, to give reasons for opinions, to clear up misconceptions, to avoid gullibility, to give further evidence, to check an explanation or hypothesis, to check observations, to follow directions for an experiment, or to check conclusions.

Using the information in the selection in some way is essential. Many pages in Science Around You address one or two questions to the reader. Here are a few of the questions addressed to the reader from pages in the book:

How do plants around you get water? page 7
How do you see thermometers used? page 35
Do you know any animals that hibernate? page 68
Do you live in a place of many changes? page 77
Can you experiment to find out? page 118
How does electricity work for you? page 121
How can you keep things from rusting? page 135

The purpose of these questions is to help children relate the selection to their own experiences and the environment around them. They should use their own firsthand experiences freely. This step in reading may lead to further observations or experimentation.

Further Experiences

Reading and discussion of the various selections in Science Around You may arouse new interests or call for more activities than space in the book permitted. This section in the Manual will provide opportunities to develop more firsthand experiences.

The experiences in this section of the Manual may also serve to care for individual differences among members of the group. The range of interest and individual differences may be as great in science as in any other subject. Children with less language or reading ability will need more firsthand experiences. With your help they may record science experiences and use these as experience reading charts. Some children may go further with the selection being studied by using these suggestions and reporting findings and conclusions to the entire group. Research reveals that gifted children with a high general intelligence are often interested in science.

Evaluation

Children's science experiences afford opportunities for child study. A desirable way to evaluate progress is to observe the behavior of the children. Does the individual question magic as an explanation of events? Is he willing to consider new and reliable information? Does he make a distinction between fact and fiction? Does he reject personification, or reference to animals and plants as if they were capable of thinking, reasoning, and planning? At more specific places in the Manual these and other questions will be pointed out to guide the teacher in evaluating the progress of the children.

Science in childhood education gives opportunities to make use of the scientific method and to make it meaningful to children. You will want to watch for evidence of children's progress in using these elements of the scientific method.

What evidence do you see of the individual sensing and stating problems?
Does he make hypotheses or give explanations?
Does he suggest ways of testing his proposals?
Does he make conclusions?
Does he check conclusions with authentic materials?

Other means of evaluating progress in science are suggested, such as using the new information to plan and give programs for other groups of children, noting ways to organize and use science experiences, working with a variety of art media to record meanings from experiences, and making group or individual records of science experiences.

As you use each selection with children, you may wish to observe how their ideas change and improve. Do they grasp the important concepts with which the chapter deals? What evidence have you that individuals have gained some understanding of the larger patterns of change, space, variety, or others? Do you see an increasing interest along certain lines? Do you see evidence of willingness to listen to suggestions, to discuss, to observe, to manipulate materials, and to check opinions and conclusions? Do you see evidence of changes in individuals as well as in the group as a whole? More specific clues to child study through science experiences will be given in the section on evaluation in each chapter.

AUDIO-VISUAL MATERIALS

You will find at the end of each chapter a list of films and filmstrips for use in the classroom. Each film or filmstrip should be previewed by the teacher in order to guide children adequately. Children should know what to

look for before viewing a film. If part of a film is above the level of comprehension or unrelated, children should understand that they are not to be responsible for such information.

There are film libraries in nearly every state conducted by departments of education, state agencies, some universities, public libraries, and museums. Information about them can be secured from the teacher's own department of education. There is also a directory of national film rental agencies in the Appendix.

THE VOCABULARY LIST

Science Around You follows the book Science Near You in the series entitled SCIENCE TODAY AND TOMORROW. It is designed for easy reading by pupils who have reached the second-grade level. The total vocabulary of this book is 439 words. Of these, 257 are introduced in Science Near You or in the first-year program of the GINN BASIC READING SERIES. These 257 words are assumed to be known to children in the second grade.

Science Around You also uses 182 new words necessary to the development of science concepts. The 77 starred words in the list below are found in the second readers of the GINN BASIC READING SERIES.

No more than three new words are introduced on any page and each word is used a minimum of three times. All variants of known words are counted as new words except those formed by adding s, es, 's, ed, and ing, and compound words of which the two parts are known.

The new words are listed below by pages. The words assumed to be known are listed alphabetically.

New Words in Science Around You

4 summer*
5 . . .
6 much*
less
7 often
roots
8 hot*
very*
9 . . .
10 ditches
11 . . .
12 autumn
woods*
meadow
13 leaves*
falling*
belong
14 leaf
buds
small*
15 Bob*
through*
winter*
16 . . .
17 well*
watch*
18 caterpillar
cover
before*
19 butterfly
chrysalis
20 birds*
fly*
lose
21 south
later
flocks
22 use*
carpet
hole*
23 sounds*
24 weather
25 city*
high*
above
26 dust
clean*
Bill

27 smoke*
dirty
28 poured
asked*
29 leaks*
evaporates
30 pitcher
cooled
tiny
31 jar
top*
32 low*
33 dark*
more*
than*
34 freezes
35 thermometer
tells*
36 record
each*
few
37 afternoon
during
quickly*
38 melt
shining
tray
39 slowly
table*
40 earth
large*
Jim*
41 park*
cars*
lake
42 only*
cities
43 ocean
44 round*
rode*
ship
45 or*
47 keeps*
starts*
48 . . .
49 shadow
sunny
50 should*
51 any
52 . . .
53 heats
hotter
stove*
54 east
smaller
west
55 . . .
56 larger
57 cloudy
58 bright*
59 . . .
60 fluffy
61 . . .
62 last*
63 . . .
64 . . .
65 . . .
66 nuts
coats*
fur
67 dead
alive*
hibernate
68 below
frozen
safe
69 colder
north
fluff
70 . . .
71 year
72 . . .
73 pine
most*
evergreens
74 Sandy
75 forth
76 . . .
77 . . .
78 beat
drum
finger
79 strike
ear*
80 spoon
swing
string
81 louder
bell*
82 clock
ticking
loud*
83 end*
stick*
better*
84 vibrate
cymbals
together*
85 push*
button
rings
86 noisy
87 . . .
88 . . .
89 . . .
90 . . .
91 getting
longer*
92 rest
93 nests*
94 lay*
tap*
95 feed
96 . . .
97 . . .
98 . . .
99 . . .
100 . . .
101 . . .
102 . . .
103 turning
bulbs
104 sparrows
105 . . .
106 . . .
107 . . .
108 . . .
109 . . .
110 friction
paper*
111 rubbing
rubs
112 try*
113 pulling*
heavy*
114 roller
115 brakes
wheel*
116 . . .
117 . . .
118 . . .
119 . . .
120 . . .
121 tracks*
122 electricity
strong
sails*
123 pumps
124 . . .
125 . . .
126 powerhouse
machines*
wires
127 . . .

128 steam*
boils
129 gasoline*
130 . . .
131 . . .
132 . . .
133 . . .
134 horses*
135 iron
rust
nails*
136 deer*
137 . . .
138 . . .
139 . . .
140 . . .
141 forest
142 country*
143 . . .

Words Assumed to Be Known

a	buzz	faster	here	Miss	pond
about	by	father's	hide	moon	put
after	call	feathers	hills	morning	rains
again	came	feels	him	Mother	ready
air	can	find	his	moved	red
airplane	candle	fire	hold	must	ride
all	care	floor	homes	my	river
an	changes	flowers	houses	near	rocks
and	children	food	how	need	roll
animals	clinkety-clank	for	I	never	rough
are	clouds	found	ice	new	run
around	cold	frogs	if	next	said
as	colored	from	in	night	sand
at	come	garden	is	no	saws
away	could	get	it	noise	school
back	cows	gives	kind	not	see
ball	cup	glass	know	now	seeds
barn	cut	goes	lands	of	seen
be	days	gone	let's	oh	she
bees	did	good	light	old	show
Betty's	do	grass	like	on	side
big	doors	green	listen	one	sing
blowing	down	ground	little	open	sky
boats	drops	grow	lives	other	sleeping
book	dry	had	long	our	smooth
box	eats	hair	looks	out	snow
boy	eggs	hard	lost	over	so
breaking	engine	has	made	part	soft
bring	experiments	have	make	people	soil
brook	far	he	many	picture	some
brown	farm	hears	Mary	places	soon
build	farmers	helps	may	plants	splashes
but	fast	her	mills	play	spring

squirrels
stay
stops
stored
streets
sun
take
that
the
their
them
then
there
these
they
things
thinking
this
time
to
Tom
tomorrow
too
took
toys
tractor
train
tree
trucks
turtles
two
under
up
us
walk
want
warm
was
washed
water
way
we
were
wets
what
when
where
which
white
who
will
wind
window
with
work
yellow
you
young
your

I · SUMMER

The first chapter in Science Around You is "Summer," and you may wish to consider it in relation to the chapters on "Autumn," "Winter," and "Spring." The plan of these chapters is to reveal some of the conditions of the changing seasons in several places in North America. The chapter on "Summer" treats the north temperate region where Mary lives as well as a semidesert place where Tom lives. "Autumn" deals with a place of many seasonal changes. The chapter on "Winter" shows many changes where Mary lives as well as Sandy's warm winter place. The chapter about "Spring" shows a region of many seasonal changes, Sandy's place of few changes, and Tom's place near a desert.

It is recognized that neither children nor teachers may have experienced summer in different kinds of places. The authors are giving a broad background for the study of seasonal change. You should develop the idea with the children that seasons vary in different parts of the country and in the world.

The chapter on "Summer" in Science Around You is a good starting point during the first week of school. Encourage your children to tell about their experiences. "What did you do? What did you see?" These questions can start lively discussions of the out-of-doors. The children who have not traveled during the summer will have had good experiences to tell about. They may have been working in flower or vegetable gardens, watering plants, caring for pets, seeing new birds around them in the summer, watching the sky change, enjoying long summer days with longer hours of daylight for play outdoors.

SCIENCE MEANINGS

You will be able to focus on some basic science meanings of the changing seasons, such as the appearance of the landscape, what plants and animals are doing in different places, changes in the work and play of people, changes in the temperature, changes in the forms of precipitation, and changes in the amount of sunlight. With guidance your children will gain some feeling for the great variety of plants around them in the summer, that there are many animals, and that climates vary in different regions.

The following lists will help you to focus on some specific science meanings as you use the illustrations in the book, guide the reading of your children, observe the outdoors, or have other experiences:

In Mary's place

There are many flowers in the summer.
There are many animals about.
Plants need water to grow.
It rains often.

In Tom's place

In some places there is little rain in the summer.
Water from irrigation ditches helps the plants to grow.
Farmers run water into the fields.
The water comes from far away.
Plants must have water to grow.

These science meanings will appear in the right-hand margin in the section "Ways of Working with Children." They are a guide for the teacher and are not used directly with the children. The children will state such conclusions in their own childlike language.

INFORMATION FOR THE TEACHER

Seasons Change. There are four seasons during a year in most places where Science Around You will be used. Although each of these seasons is of about equal length, conditions, such as the amount of sunlight, the warmth of the air, and the amount of moisture, will vary.

Much sunlight comes to the earth during the summer. The temperature of the atmosphere is fairly high. Plants are most active making food and grow rapidly in the summer. They make more food than they can use immediately. This excess is stored in various parts of the plants. By storing food they become adapted and survive. Plants in dry places may not grow in summer. Their growing seasons may be autumn or winter, whenever the rains come.

Animals are very active in the summer. If there is an abundance of food, they may find it easy to obtain more than enough. They may eat much food and store some of the excess in the form of fat. Thus some animals become adapted to survive adverse conditions and may live for months without eating. Insects are usually numerous. Some species of birds are found north of the Arctic Circle and some south of the Antarctic Circle during the summer months.

Many Kinds of Plants. Spring and early summer are the usual growing times. Some plants germinate from seed, grow, blossom, produce seeds, and die within a year. This is the life cycle that is repeated with such annuals as corn, oats, beans, and peas.

Some plants require two years to grow from seeds and to produce seeds. This is the life cycle that is repeated with such biennials as beets, carrots, hollyhocks, and many of the clovers.

Some plants live for years, producing seeds each year after they have matured. This life cycle is repeated by such perennials as trees, shrubs, and many herbs.

Seeds become a means of the survival of plants and reproduce other plants of the same kind. This is a concept of adaptation that you may help your children to discover.

Water and Its Importance to Life. Water is one of the most important factors determining the kind of plant and animal community. The abundance or scarcity of water is probably more important than any other single factor. Mineral substances from the soil are dissolved in water and then taken into the roots of plants for use in making food. Most animals can survive longer periods without food than they can without water. The availability of water is an important factor in determining the kinds of plants and animals found together in a community.

Water is necessary to plant life for the food-making process and for the transportation of the manufactured food from one part of the plant to another. Plants have difficulty in surviving during a drought if there are too many plants in a given place, and some may die. Weeds seem to be able to survive drought conditions better than cultivated plants and use much water needed by the other plants.

Rainfall. Water is present in the atmosphere in different amounts. Under certain conditions water condenses and falls in some form of precipitation. The distribution of rainfall is exceedingly irregular which makes for vast areas ranging from hot deserts to wet swamplands. In Science Around You Tom's place is near a desert while Mary's place is where it rains often.

Wherever rainfall is inadequate, irrigation is essential to farming. If the seasonal distribution of rain and snow produces a dry growing season, irrigation is needed.

Irrigation. In some of the western states irrigated regions get their water from rivers that rise in the snow-covered or rain-swept mountains. Some of these rivers are the Columbia, Missouri, Colorado, Sacramento, and their tributaries. Water is sometimes stored in a reservoir, or lake, for future use. Canals carry the water from the reservoir to the area to be irrigated. Smaller ditches, or laterals, carry the water to the fields. When water is needed in a field, gates in the laterals are opened and the water runs into furrows between the crops or trees.

WAYS OF WORKING WITH CHILDREN

Pages 4-5. In the Summer

There are many flowers in the summer.
Plants grow in many places.

Interpreting the Outdoors. As the children look at the illustrations on pages 4 and 5, they will probably say that it is summertime. Is it summer now where you live? Do you have some flowers around you like the ones shown? It is not necessary to identify the plants in the illustrations. You might wish the children to see how many kinds of plants grow in water, near the pool, in the sunshine along the fence, or in the field.

Observing Many Kinds of Plants. Could you take a walk to a flower garden at the home of one of the children, to a park, or to a meadow? The edges of school grounds are often interesting. You might visit a weed patch with the children. Help them to see the kinds of places where the plants are growing. As the children discuss the many kinds of plants, they are learning more and more about the variety of plants, that plants grow in different kinds of places and under different conditions.

Try to observe the behavior of your children to see what attitudes and values are revealed as well as the facts they are learning. Do individuals show a genuine interest in the outdoors? Do their interpretations of living things contain misconceptions? If so, do they show a willingness to listen and to consider new information?

Plants are usually green in the summer.
There are leaves on the trees in summer.

Learning How to State Hypotheses or Questions. Do your children notice the leaves on the trees in the illustrations? Do they discuss how green everything looks? These questions might lead to another walk outdoors.

Do your children discuss when they expect the leaves to change color and finally drop? This is a way to help children to think objectively. Encourage your children to offer explanations. When children state in one season what they expect to happen in another, they may state hypotheses. Sometimes it is wise to discuss or anticipate changes in other seasons. In this way you may help the children to know more fully the seasons through the year. You may wish to make return trips to the same spots to watch changes through the year. In this way you help children to check the hypotheses they made earlier.

There are many animals about in the summer.

Stating Questions and Problems. What animals do your children notice? Do they see any of these animals around them in the summer? What other

animals can they tell about that are around in the summer? Begin to develop such questions or problems as: "What animals are around in the summer? How do they get water? Where do they get water?" Use the children's comments or questions whenever possible instead of the ones suggested here.

Observing Animals Outdoors. Could you take a walk near your school or in a park to see a few animals that are about in the summer? There are advantages in taking short but frequent trips with young children. During such trips observe the behavior of your children. Do they notice the many ways in which the animals move and the different mouths, ears, noses, or coverings of various kinds of animals? Does their behavior reveal that they have a healthy curiosity or fear? Too often children's curiosity is changed to fear by observing fearful behavior among other children or adults.

Reading About Summer. You may wish to use the preceding approach before actually reading page 5. Point out the title "In the Summer." Introduce Mary to the children. Suggest: "What is summer like where Mary lives? How does it look outdoors in summer?" Reading is usually guided by a question, preferably one of the children's.

Note the question on page 5. A discussion of the question may bring out some contrasting conditions with those in the illustration.

Making Charts. As your children observe around them, they will need help in organizing what they learn. A chart about the animals they see around them in summer may be helpful. The chart might be illustrated with the children's own interpretations of the animal, how it moves, where it might be found, or what it eats.

The following chart suggests one way to help children organize and record from their observations:

ANIMALS IN THE SUMMER				
In the Woods	In a Park	On Water	In a Yard	On a Farm
chipmunk rabbit	flicker sparrows	ducks frog	squirrel blue jay	skunk bats

Plants need water to grow.

Pages 6-7. Water for Plants

Interpreting Conditions for Plant Growth. You will note that these two pages focus on some of the conditions necessary for plant growth. For

example, plants need water. After reading the title with the children, use the illustrations at the top of page 6 to help them establish their own purposes for reading. Help the children to understand that some kinds of plants are called annuals; that these plants have to be replanted each year; and that Mary has just watered the plants. Contrast the dry and moist soil.

Some plants need much water.

Checking Facts by Observing. In the illustration at the bottom of page 6 note that some plants are in the water (water lilies) while some plants grow near the water or partly in soil (water cress). If possible, go outdoors to look at the variety of plants growing and to see how much water they seem to need.

Sometimes it may not be possible to go outdoors for an instructional excursion. Then encourage discussion about past experiences.

You may wish to make two lists of plants after your trip outdoors. One list might include some plants that need much water; the other, some plants that need less water. Try to use the new words much and less in conversation. If the children can have this concrete experience first and use new words in their conversation, the reading will be much easier. Should a difference of opinion occur about what was seen, check the facts by taking another look outdoors. This is a way to help the children think more objectively. See page 5 of this Manual on objective thinking.

Checking Facts by Reading. Now the children might read to check their observations with the text on page 6. They should, however, read in response to questions, such as: "What do plants need? Where do plants grow?" The trip outdoors might come after the reading of page 6. Then direct the children's observations by using the question, "Where do you see plants around you?" You will, of course, always use the children's questions or comments when possible to guide their reading.

In some places it rains often.

Interpreting Sky Conditions. On page 7 note the dramatic sky conditions in the first illustration. Explain that the dark cloud is called a rain cloud. If possible, take time to go outdoors to look at the sky. If this is not possible, use the windows of your classroom or halls. Let the children tell about the sky conditions they see.

Is your place similar to the place where Mary lives? How is it different? Does it rain often where you live? Is there little rain?

Use the new words on page 7, often and roots, if possible during your discussions. Guide the reading with questions, such as: "Does it rain often where Mary lives? What does the rain do to the ground?" Use other

questions if you prefer. Discuss how much rain you have where you live. Do plants and animals get enough water from rain?

At the bottom of page 7 do your children note that plants grow above and below the ground? Discuss the wet appearance of the soil. Bring out that this water goes into the roots. It is essential that children see the roots as part of the whole plant.

In answering the question on page 7 the children may discuss what happens to plants during a drought.

Painting Summer Scenes. After the children have had several discussions, observed summer conditions outdoors, and read the text, they may be able to express their own ideas through painting. Cold-water paints and paper 16" × 24" might be used. What they paint should be a matter of their own choice and as they see it. They will reveal their own interpretations. However, they may reveal some misconceptions. Then you might suggest that they take another look, if possible.

In some places there is little rain in the summer.
Farmers run water into the fields.
Water from ditches helps the plants to grow.

Pages 8-9. Dry, Hot Summers

Discussing Dry, Hot Places. Introduce Tom to the children. The place where he lives might be contrasted with a region such as Mary's or their own. Mention the fact that Tom lives far away from Mary. Note the desert plants, the horned toad, and the jack rabbit. Tom lives in a place where there is very little rain. It is hot and dry. It is a desert.

Use the children's questions or ask such questions as: "How do you think the plants in Tom's garden get water? Where do you think plants have enough water?" Do the children notice the small ditches where there is water between rows of plants; that the plants are green near the water; and that they are growing?

Using a Globe. To show how far away Tom lives from Mary, you might put a small dot of plasticine or clay on a globe to make a place in Arizona for Tom's place and another dot for Mary's place.[1] Mary's place could be anywhere in the north temperate region where there is adequate rainfall for plant growth in summer. Help your children to locate the place where they live on the globe. Do they live near or far away from a hot, dry desert? Do they

[1]A plain table-stand globe with axis is recommended, such as the 16-inch, No. GP161. A. J. Nystrom and Company, 3333 Elston Avenue, Chicago 18, Illinois.

seem curious about a desert? Are they curious about faraway places? What evidence do you have that they are interested in places different from their own?

Using New Words. You have no doubt used hot and very in your conversation about the illustration. This helps children to know the meaning of new words before trying to read the printed words. Such a practice should be followed in using new words on each page of Science Around You.

Reading to Verify. After much discussion and use of illustrations, your children may say that it must be hot where Tom lives. Now they might read pages 8 and 9 to find out for sure. The reading might be guided by the children's questions, such as: "What kind of place is it where Tom lives? Does it rain often? What do the plants in the garden need in order to grow?" There may be a difference of opinions among the children. Then they might reread for facts in order to be sure or to clear up misconceptions.

Plants must have water to grow.
The water comes from far away.

Pages 10-11. Water from Far Away

Discussing Places with Little Rain. You might wish to help the children note the appearance of desert plants in the picture. Are they different from plants around you? How much water do the plants need? Encourage children to tell about any time during the summer when there was little or no rain. What happened to lawns, gardens, and flowers? How did the air feel? How high did the temperature on the thermometer go? Point out that it is dry like this nearly all the time where Tom lives; and that dry, hot places without rain are called deserts. Use a globe to point out the desert areas in Arizona, northern Mexico, or other desert regions. From the picture on pages 10 and 11 see if the children question the fact that there is little or much rain where Tom lives.

Reading for Facts. Differences in opinions make a good purpose for reading to find out for sure. Do your children notice and discuss that plants are growing where there is water; that the plants are green; and that there is water in the ditches? Guide the reading with questions from the children, or use your own question to guide the reading. You may wish to ask: "How does Tom help the plants to get water? Where does the water come from?"

Think of reading as discussion and reading. Give the children time to respond to all the questions. In general, this practice should follow throughout the use of Science Around You.

Stating Conclusions. Help the children to trace the source of water in the garden, through the big ditch, to the snow-capped mountains in the back-

ground. Bring out that the snow melts and runs down the mountains into streams and rivers. With such a development you can help the children to conclude: The water comes from far away; it comes from the snow far away.

Let the children freely discuss the question on page 11: "How does water get to plants near you?" Does it rain often in the summer? Do people water lawns and gardens often? Is it dry like a desert?

Discovering by Experimenting. If possible, secure small cactus plants. Do your children notice the color, sticky spines, and toughness of the plant? Help your children to discover by experimenting how often cactus plants need water. How much water is needed? How often do the children water their cactus plants? Do these plants need water to grow? Vary the amount of water and the amount of time between watering the plants. What changes do you see?

Recording Results of Experiments. You may wish to compose short group paragraphs about your experiments. At other times it is helpful for children to use a large outline chart to organize and record what they are learning. They fill in the details or changes as they observe them.

EXPERIMENT WITH PLANTS AND WATER Do cactus plants need much water?			
Date	Kind of Plant	Amount of Water	What happens to the plant?

MATERIALS NEEDED

You will need the following materials for experiences and experiments suggested in this section of the Manual:

aquarium
cactus plants
clay or plasticine
dish (for indoor garden)
flowerpots (2)
globe (with axis)
paints (cold-water)
paper (16" × 24")
pebbles
rocks (for rock garden)
seeds (Lima-bean)
soil (rich)
stopper (for one flowerpot)

FURTHER EXPERIENCES

Some children may need more firsthand experiences before they are able to reach conclusions. Other children with special interests may have further experiences and share these with the whole group. In this case, the children should be helped with such skills as: How to show an experiment to others so that they may understand it. The following experiences, or others of your choosing, will help you to go beyond those suggested in Science Around You.

Watching Water Get to Roots. Use an old aquarium for this experiment. Place a layer of pebbles on the bottom of the aquarium to provide better drainage and then fill it about two-thirds full of rich soil. Use two porous flowerpots, inserting a stopper into the drainage hole of one pot. Sink the two flowerpots into the soil in opposite parts of the aquarium. Place some Lima beans (seed) between the soil and the sides of the glass aquarium as well as throughout it. Fill with water the flowerpot that has the stopper in it. Keep it filled with water. The other flowerpot remains empty.

Encourage children to make predictions (hypotheses) about what may happen. What do they expect will happen? Record the hypotheses. Check these hypotheses with what you observe. You may be able to observe that the roots go down and the stems go up above the soil. After about three weeks remove both pots. Which pot had the most roots near it? Guide the children in stating their conclusions, such as: "Plants get water through their roots; plants need water to grow." Help the children to record this experiment.

Observing How Plants Change. Encourage the children to observe how plants grow and change through the seasons. You may wish to make a small rock garden. Is there a spot on your school grounds on a slight incline or slope where erosion is taking place? Is it in a sunny or shady place? Choose appropriate plants for a sunny or shady spot.

Look at the picture of the small rock garden in Mary's yard on page 4 of Science Around You. Help your children to see how plants and rocks will help to hold the soil. Help them to select appropriate rocks for their rock garden. They will need rocks that have a wide base. About half of each rock should go into the soil, making a good pocket for the roots of plants. Such plants as sedum make good ground cover and help to hold water in the soil.

Should you not have space outdoors for gardening, you may wish to make indoor dish gardens. Watch the amount of light and water that your particular plants seem to need. Keep a record of your observations.

EVALUATION

There are many ways in which to evaluate the progress of children in science. Your science experiences offer rich opportunities for child study.

What evidence did you see of increasing interest in changes around you? Did your children grasp the importance of water to living things? Are they more aware of the great variety of plants around them? Were they interested in faraway places, such as a desert? This will reveal their feeling for the large pattern or idea of space. Did you observe a willingness to check opinions and conclusions by observing again if necessary, to experiment, and to read? If so, the children are using some elements of the scientific method discussed on page 6. What other clues did you get in spontaneous comments?

The following activity should call for facts used in this chapter. Plan a series of large pictures (about 18" × 24") or a mural (about 15' × 4'), using cold-water paints to summarize the important experiences which the children have had. Their discussions and paintings might reveal some important science meanings, such as: There are many kinds of plants growing in the summer; in some places it rains often; plants need water to grow; or there are many animals about in the summer. This picture record might be kept in order to compare it with records of the children's experiences through the other seasons of autumn, winter, and spring.

In case there has been a drought during the summer, these conditions might be revealed in the painting. Children living in or near a desertlike place would, of course, show plants, animals, and sources of water around them.

You might wish to have your children tell another group about their experiences. They might explain experiments, murals, charts, and pictures. Then you may notice their grasp of the science meanings you have been developing and clarify misconceptions.

How well do your children use the new science words from this chapter, such as summer, roots, hot, and ditches? What are their concepts of these words? You might wish to make a picture dictionary of new science words. Organize each page to show the word, its meaning in a sentence, and a picture to illustrate the meaning of the word.

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Films

Irrigation Farming. (EBF) 1 reel, b/w. Shows the use of resources to prepare a piece of land for vegetation.

Plant Growth. (EBF) 1 reel, b/w. Shows plant growth from sprouting of seed to the seed dispersal of a plant.

Planting Our Garden. (EBF) 1 reel, color. Depicts the activities of planting a vegetable garden. Shows seed germination and development, as well as conditions necessary for the growth of seeds.

Summer on the Farm. (EBF) 1 reel, color. Shows the growth of plants and animals, as well as changes in recreation and work as the seasons pass.

Wonders in the Desert. (C-W) 1 reel, color. Jimmy and Joan walk over a desert trail and learn about living things. They see a jack rabbit, a burro with its young, a horned lizard, a pocket mouse, and a desert tortoise.

Filmstrips

In the Summer. (YAF) color.

Summer on the Farm. (SVE) color.

II · AUTUMN

In some places children experience many changes in the autumn. They feel cooler air and dress accordingly. There is less time for outdoor play before dark. Nights are longer. A child may get up before there is much daylight.

Children see changes made by living things. Change in the color of the leaves is obvious. Children tend to pick colored leaves from trees or the ground. They like to jump into great piles of leaves. They see that leaves wrinkle and break up. You can help your children to gain the larger concept that decaying leaves help to enrich the soil.

Children see and feel the covers of many seeds. They tell of seeds sailing through the air or floating on water. You can help them to see that seeds are moved about in many ways; that too many seeds do not grow well in one place; and that they may grow far away from the parent plant.

Children tend to collect and bring indoors butterfly chrysalises, moth cocoons, and other insects as well as plants. This kind of behavior needs guidance. The chapter about "Autumn" will help your children to gain a better concept of the wise utilization of the out-of-doors.

In the chapter on "Autumn" children will give their attention to normal seasonal changes found in the north temperate region where Mary lives. These changes frequently occur in much of the United States, in the southern part of Canada, and to some extent in parts of Mexico. Children who live in places of different conditions have an opportunity to read and make comparisons with their own places.

SCIENCE MEANINGS

The large ideas or patterns of change, adaptation, and interrelationships are developed through the following science meanings:

The leaves of some plants change their colors in the autumn.
Parts of plants should not be pulled off unless necessary.
There are leaf buds on many trees in the autumn.
Seeds are moved about in many ways.
Seeds may grow far away from the parent plant.
Some animals make changes in the autumn.
Leaves help to make good soil.

INFORMATION FOR THE TEACHER

Changes Made by Plants in the Autumn. Change and variety are revealed in the many kinds of climate, in the range of temperature, in the length of the growing season, in the amount of rainfall, and in the variation of rainfall within a season. These factors combine in various ways to make many kinds of environments for living things.

As the seasons change, you see the adaptations of living things in the parks, woods, fields, meadows, and yards. Some of the most obvious adaptations of plants in the autumn are changes in color and falling leaves. These changes are adaptations made by plants in order to survive unfavorable conditions.

Why Trees Lose Their Leaves. Some plants, such as maples, oaks, poplars, and many other kinds of trees, lose their leaves annually. The changes in the plant which cause the leaves to drop off help them to survive the winter.

Before the leaves fall in the autumn, a separation layer is formed at the base of the stem of each leaf. This layer prevents water and food from entering the leaf. When the layer is fully formed, there is nothing to hold the leaf to the tree and a slight breeze will blow it off. Many oaks and some other trees may form this separation layer imperfectly or not at all, and the leaves are retained on the trees for a great part of the winter. The dead leaves fall off when the buds begin to grow in the spring.

Why Leaves Change Color. In the autumn the leaves of a deciduous tree often turn red, yellow, orange, or brown before the separation layer is completely formed. The food-making processes have stopped. The chlorophyll, or green-coloring matter, is not active. There have been color pigments present all summer but they could not be seen because of the chlorophyll. Young leaves in the spring show yellow or red pigments before the chlorophyll becomes active.

These same changes may take place in the summer if there is insufficient moisture. The fall of leaves is an adaptation made to meet drought conditions.

Bud Formation. Trees and shrubs develop buds during the growing season until about the middle of July. Then the buds remain dormant until the following spring. Within the buds are a little stem and rudimentary leaves. These buds are covered with overlapping layers of scales in cold and arid climates. Some buds contain only flower structures and still others contain both the leaf and flower structures. Buds vary in their amount of activity, and some may die because of an insufficient supply of food, attacks by insects, disease, or freezing.

Buds contain the leaf, stem, and flower parts for the next year's growth. They survive the cold weather and are adapted for rapid growth when conditions of warmth, sunlight, and moisture are most favorable. Then the tiny structures within the buds grow and grow. They become the plant's new leaves, stems, or flowers.

Seeds. Many plants, such as the annuals, are not adapted to meet the conditions of cold winter. Therefore, they do not survive. In these plants the seed is the only means of survival year after year. A new plant grows from a seed. The food in the seed is used by the young plant until its green leaves are able to make food.

Seeds Are Scattered. The seeds of many plants get moved by wind, water, or animals. Some seeds fall to the ground far away from the parent plant. Thus they have a better chance of surviving since they are not competing with the parent plants for space to grow in, for light, water, and the raw materials of the soil. Many seeds could not grow well under or near the parent plant. So many seeds could not have the necessary conditions for life.

Animals Make Changes in the Autumn. Animals are dependent upon certain conditions. They do best when it is not too cold or too hot, too wet or too dry. Animals everywhere are more or less well adapted to the environments in which they naturally live. In the temperate zones there are great differences in the living conditions, as everyone knows. The animals that naturally live in these regions (that is, not brought there by man) are more or less well adapted to the great changes of the various seasons. To survive they are adapted to meet changing conditions of temperature, food supply, and sunlight. For example, some birds migrate to other places. Some insects remain in a dormant stage during the cold winter. These adaptations to changing conditions enable many animals to survive and to reproduce more of their kind.

Insects Make Changes. Some moths and butterflies lay eggs in the early part of the summer. Some may lay eggs on the leaves of plants. The eggs are small but different in shape and color. A few days after the eggs are laid, most of them hatch. Caterpillars come out of the eggs.

Just as each kind of moth or butterfly lays a different kind of egg, so the caterpillars are different. These caterpillars eat a great deal. They eat the green leaves from nearby. On page 18 of Science Around You, you will see a butterfly caterpillar on a milkweed. Soon the caterpillar becomes so large from eating that its skin splits. The skin splits down the middle of its back and the caterpillar crawls out. A caterpillar eats, grows larger, and sheds its skin four or five times.

Then another change takes place during the autumn. By this time a caterpillar has grown to its full size. It makes a cover around itself. A cover

made by a moth caterpillar is called a cocoon. A cover made by a butterfly caterpillar is called a chrysalis. A cocoon is made by a caterpillar spinning a thread around itself. The thread of liquid comes from within the body of a caterpillar and it hardens as soon as the air touches it. On page 19 of Science Around You, you will see a chrysalis made by a caterpillar. It is protected by the chrysalis. Changes take place in the cocoon or chrysalis.

The cycle described in the preceding paragraphs may occur in some kinds of moths or butterflies several times during the warm months. Pupae that are formed in late fall may remain as pupae during winter months and emerge in the spring.

Thus, these insects become adapted to seasonal changes and may survive cold winter days. You will need to help the children understand that cocoons and chrysalises belong out of doors; that if children take them indoors, they may come out too soon; that it is too cold for them in winter; and that in the spring, when it is warmer outdoors, it will not be too cold.

Migration of Birds. Many kinds of animals, especially birds, migrate. In this way they escape the hardship of cold winters. Scientists are not sure why animals migrate. Some claim that they are affected by such factors as shorter hours of sunlight, lower temperatures, and scarcity of food as the cold winter approaches.

Birds seem to follow various routes, but a given kind of bird follows the same route year after year. Birds nesting regularly in the central part of the Mississippi Valley and eastward usually follow a route to western Florida and Louisiana. Then they make a nonstop flight of more than five hundred miles over the Gulf of Mexico. One of the most dramatic flights is that of a hummingbird. These little birds fly across the Gulf of Mexico each autumn and spring.

Birds such as the thrushes, tanagers, warblers, and vireos fly at night. Some birds migrate either during the day or at night. These are ducks, geese, or birds which live along the shores of lakes or streams.

WAYS OF WORKING WITH CHILDREN

Some leaves change color in the autumn.

Pages 12-13. Changes in the Autumn

Planning Experiences. Before you begin this unit of experiences, examine the entire chapter in Science Around You as well as the entire section about the chapter in this Manual. Note where you and the children may have firsthand experiences outdoors.

You might wish to plan with the children a walk to look for autumn changes. After one trip with such a broad purpose, short trips to look for more specific details may have an advantage.

Discussing Autumn Changes. Tell the children these two pages show where Mary goes to school and that the teacher's name is Miss Day. Encourage the children to comment freely about the color of the leaves, the milkweed, and the thistle in the illustrations. Ask: "What time of year is it now? Is it autumn around us now? How do you know? What changes do we see?" Encourage the children to discuss autumn changes shown in the pictures, changes they see on the way to and from school, or changes they see from their classroom windows.

You can easily use such new words as autumn, meadow, and woods in the conversation. Help your children to see that these pictures show a variety of places (habitats), such as a woods, field, meadow, brook, and thicket of trees. Are the habitats near your home similar or different?

Checking Accuracy of Statements. Help your children to make comparisons with their own season. You might plan with your children to look outdoors again to see if their statements about changes in the autumn around them are true. This helps children to check for accuracy and to think more objectively.

Children will try to get the best statement of truth available when they are so guided. You will further this process by using elements of the scientific method. You can do this by encouraging discussion, asking questions, giving reasons, checking statements by observing, experimenting, and reading. How can we find out? What are your reasons for your statement? How do we know this is true? How may we check or test the idea?

Reading to Find Out. Guide the reading on page 12 with the children's questions or comments or with a question, such as: "Where do you think the children and Miss Day are going?" After responses from the children say, "Let's read to be sure." Modify these suggestions as you wish. Some children may be mature enough to grasp the idea that red and yellow colors were in the leaves during the summer but that you could not see them because of the green.

Parts of plants should not be pulled off unless necessary.

Using the Outdoors Wisely. Observe the behavior of the children on the first trip outdoors. Do they tend to pull off leaves or break branches of trees impulsively? This may not be unusual. Help the children to check their action and ideas by reading page 13.

In the illustration note that children are picking up colored leaves from the ground. You can help your children to understand and to conserve living

things. When leaves are needed for study, it is a good practice to pick them up from the ground. Plan frequent trips to the same spots to watch the change in color and the falling of the leaves. You may wish to compose experience reading charts with the children.

Do your children show that they accept the ideas on page 13 when they go outdoors now? Do they agree or disagree? With such experiences you help children to develop some understanding of the relationships between leaves and trees. Thus, they may accept a greater responsibility for the environment.

There are leaf buds in the autumn.
New leaves will grow out of buds next spring.

Page 14. Leaf Buds in the Autumn

Stating Proposals—Hypotheses. Encourage the children to talk about flower buds and leaf buds that they have seen. Children who have been unaware that a leaf bud starts to grow long before the leaf itself grows may express doubt. Do they challenge you or each other? Look upon such behavior as an opportunity to help them change a misconception experimentally, rather than merely telling them what is true. For example, guide them in selecting a certain tree to watch until spring. Also help them to express their idea as a proposal or a hypothesis: We shall watch the leaf buds to see if leaves grow from them next spring. Helping the children to say what changes they expect to take place is one way of helping them to state a hypothesis. Thus they learn to think more objectively.

Examining Leaf Buds. The children should certainly look at and feel the hardness of leaf buds. If possible, examine a variety of leaf buds under a large reading glass. You may wish to open a few leaf buds carefully and see the tiny folded leaf within each bud. The children may read page 14 before or after examining leaf buds. Do they agree with the facts on page 14?

Such new science words as leaf, bud, and small should be used during the discussions before reading the text. Children need a concept of a word before reading it in print.

There are many seeds in the autumn.
Parts of plants should not be pulled off unless necessary.

Page 15. Seeds in the Autumn

Seeing Many Seeds. On page 15 children may know from their own firsthand experiences such common plants as the thistle, the dandelion, or the milkweed. Discuss common plants growing in the fields or the meadows near you.

What kinds of seeds do you see in the autumn? Do the children see many differences in sizes, shapes, and colors of seeds? Then you are guiding the children in the larger pattern of variety.

Examining Seeds Outdoors. Take time to go for a walk to a meadow, a yard, a field, or some place where plants are growing in a natural state. You can probably help the children's thinking by guiding their conversation along these lines: There are many, many kinds of seeds in autumn; many will grow into new plants next spring; and seeds belong outdoors. Plan to watch the seeds outdoors. If this is not possible, encourage the children to tell about seeds they see near their homes, in the park, on the school grounds, or in vacant lots.

Reading and Predicting. Use the illustration on page 15 again. Ask: "What do you think the children did with the seeds they found? What would you do with seeds growing outdoors?" Read page 15 to see what Bob and Mary do about seeds. Do your children agree or disagree with Bob and Mary about seeds? If they agree, they are probably developing a feeling for the large pattern or idea of the interrelationships of living things.

Changing Attitudes and Values. You may have children like Bob in your group who wish to take living things back to the classroom. Help the children to see that Bob changed his attitude here. The test of a changed attitude is in action. You might take another trip after reading page 15. Do the children tend less to pull off parts of plants? Do they feel that parts of plants should not be pulled off unless it is necessary? Do you sense a change in behavior when they tell about family trips outdoors?

Many seeds cannot grow well in one place.
Seeds are moved about in many ways.
They may grow far away from the parent plant.

Page 16. Seeds Are Moved About

Giving Explanations. The children may think of the dog with burrs stuck in his hair, as being funny. Accept what seems like natural humor to the children. Let them enjoy what appears to be humorous to them. You will in time return to the following important concepts which are being developed: Many seeds cannot grow well in one place; they may grow far away from the parent plant; they will grow next spring. Encourage the children to give their own explanations as to how seeds are moved about.

Reading for Information. During a walk outdoors or through use of the illustration elicit such questions as: "What happens to all the seeds we see in the autumn? How do seeds get moved about? Why is this important?" These questions or others will serve as good purposes for reading page 16.

Using Questions. Note the two questions at the bottom of page 16. Help your children to answer these questions from their firsthand experiences.

Many seeds cannot grow well in one place.

Page 17. Experiments with Seeds

Testing Proposals by Experimenting. After you read the title and note how the seeds are growing, see if the children can state some hypotheses, such as: Mary's crowded seeds will not grow well. Bob's seeds will grow well. What do the children expect will happen? Can the children test out these hypotheses by planting Lima-bean seeds (obtain seed Lima beans) in a flowerpot or some other container? Read page 17 to check opinions and directions for experiment. Read parts aloud if necessary to check ideas.

Checking Conclusions. What conclusions are reached? Help the children to keep a written record of their observations and conclusions. A chart somewhat like the one below will help the children to organize their observations.

EXPERIMENTS WITH SEEDS			
Date	Many Seeds	Date	Few Seeds
Oct. 1	We planted many seeds in a flowerpot. We watered them. Will they grow well?	Oct. 1	We planted a few seeds in a flowerpot. We watered them. Will they grow well?
Oct. 6		Oct. 6	

Some animals make changes in the autumn.
Some animals get new covers.

Pages 18-19. Animals Make Changes

Discussing Changes Made by Insects. Use the illustrations on pages 18-19 to see the changes made by the monarch butterfly in the autumn. Let the children tell about their own experiences with insects, such as seeing an egg, a caterpillar, a chrysalis, or a butterfly; watching caterpillars eat a great deal; and finding out that they make a cover before winter comes. These changes may be seen as means of adaptation to conditions.

The authors believe that children like and use such science words as caterpillar, cover, chrysalis, and butterfly. Help your children to get concepts of specific words. Concepts of such words come through firsthand experiences, discussion, and reading.

Insects should be left outdoors.
Certain conditions are necessary for life.

Watching a Butterfly Chrysalis Outdoors. In some places you may find all the stages in life of the monarch butterfly. Look for them if possible. Should you find a chrysalis outdoors, you might tie a colored cloth on a limb near it. Watch the chrysalis outdoors. Outdoor conditions are best for it. In the warm indoors the butterfly would come out too soon and would not live. The insect is in a dormant stage now. This is an adaptation which helps it to survive the cold weather conditions.

Acquiring Desirable Attitudes. You will see again on page 19 the concept of leaving living things outdoors. As meanings accrue from many experiences, children may generalize for themselves. Desirable attitudes come from such thinking. This is their basis for action.

Birds are quiet in late summer and early autumn.
They are molting.

Pages 20-21. Birds in the Autumn

Giving Explanations. Encourage the children to interpret what the birds may be doing. What are they doing around you now? There may be suggestions about the birds not flying much or losing their feathers. Note that the children in the illustration are near a dense growth where birds might be seen. Discuss such questions as: "Where do you see birds around you most often? Are they quiet or noisy in the autumn? Why do they stay near the ground (molting)? Do you see feathers on the ground? What does this mean? Are the birds losing some old feathers and growing new ones?"

Checking Statements by Reading. Use the children's questions or give them a clue to guide their reading by saying, "Let's read the first three lines to find out what the birds are doing now." After the reading note the fact that in the illustration the children are picking up bird feathers. Encourage the children's explanations (hypotheses) as to what is happening to the birds' feathers now. Check their ideas by reading the last four sentences to find out if their hypotheses are true.

Perhaps you would like to keep a chart of the new science words. Include ones on pages 20 and 21, birds, lose, fly, flocks, and south. The children should help to make the chart.

Autumn is the moving time for birds.
Birds leave at different times.

Observing Birds Outdoors. Preceding the use of page 21 could you take a walk to see what birds are doing? Or, encourage the children to tell of

their observations made before and after school. During late summer and early autumn children often say that birds have already gone away and that they do not see them around. Note in the illustration that the birds are eating in little flocks. Bring out in the discussion the following concepts: While new feathers are growing in, birds do not fly high; as the days grow shorter and cooler, some birds migrate; and some birds may leave next week or later.

Leaves make a thick carpet.
They break up.

Pages 22-23. Use Old Leaves; What Changes Do You See?

Using Old Leaves. These two pages are intended to give further experiences suggesting changes in the autumn. In the first picture on page 22 note the brilliant ground cover of leaves. Focus discussion on the action of Mary and her father looking at the leaves under the colored ones. How do your children think the leaves under the colored ones look and feel? See if they can suggest from their own experiences how these leaves look and feel. Read the text to find out what is happening to the leaves. Can you have a firsthand experience like this with your children? If there are many leaves on the ground now around you, what color are they? Is the ground cover of leaves different from one season to another?

If you live in a place like Mary's, compare the ground cover in summer with autumn. Make a picture record of changes that you see.

Leaves help to make good soil.

Such a practice as the one shown in the illustration at the bottom of page 22 should be encouraged. It is a wise conservation practice in which many children both at home and at school can engage. It will help to build the concept of the decaying process if children can see and feel leaves wrinkling, crumbling, turning brown, and breaking up. Then in the spring they will see how these decayed leaves become a part of the soil to enrich it. In this way children may develop a greater understanding of the interrelationships between plants and soil.

Experimenting with Leaves. Are there many leaves on your school grounds? Could you and your children make a compost pile? Use the second illustration on page 22 for help. Watch the leaves in the pit all through the winter. Listen for the words your children use to describe the decaying process of the leaves. Examine the leaves and see how they are breaking up. Could you use these decayed leaves to enrich the soil during the spring planting?

MATERIALS NEEDED

You will need the following materials for some of the experiences and experiments suggested in this section of the Manual:

- bulbs
- cloth (colored)
- dish (for bulbs)
- flowerpots
- paints (cold-water)
- paper (wrapping)
- reading glasses
- rocks (small)
- seeds (Lima-bean)
- string

FURTHER EXPERIENCES

Children have many experiences with the changing seasons. A few were selected for Science Around You. Other activities might also be carried out.

Recording Observations. Give some attention to ways in which the changing seasons affect people. You may wish to help the children use their own experiences in planning a large pictorial record. Cold-water paints and large wrapping paper might be used. In such an experience you might have scenes which develop such concepts as: Autumn is the harvest season; food is gathered; preserved or stored; fathers and mothers get ready for winter; children play in leaves; or people wear warmer clothing.

Having a Harvest Fair. You might wish to help the children organize a harvest fair. However, if wild seeds, for example, are to be exhibited, every opportunity must be used to help children learn what and how much should be taken from the outdoors. This entire chapter has been focused on leaving living things outdoors when possible. Should there be enough seeds to insure next spring's plant growth, it would be satisfactory to take a few seeds. Guiding children in choices and decisions is essential. The fair might exhibit many ways mothers or children have preserved foods for winter and show pictures or murals.

Observing Leaf Buds Through the Seasons. Watch leaf buds as the seasons change. Your children might tag the limb of a tree with a string or colored cloth. It would be helpful to secure a few good reading glasses so the children may have an enlarged view of leaf buds.

Discovering Food Stored in Plants. Some new plants grow from bulbs. Since bulbs will be used in the chapter on "Spring," you may wish to prepare for the experience and plant some in the autumn. You may wish to use tulip, daffodil, or narcissus bulbs. Some concepts to keep in mind are: Plants store food for future use; some plants store food in their leaves.

An onion is a kind of bulb that might be used for experiments. Feel the thin, dry, dead outer leaves and the inner fleshy leaves where food is stored. Cut the onion open. Note the stem in the middle.

Grow some bulbs without soil. Plant narcissus bulbs in a dish where small rocks and water have been placed. Note that food for plant growth comes from the bulb.

The children may be moving in the direction of an understanding of the adaptation of plants to survive by the stored food in their parts.

EVALUATION

There are many ways in which to evaluate the work of the children. You may wish to use the experiences on page 23 for this purpose. Days or even weeks may have passed since you started this work. The questions on page 23 will tend to develop later changes outdoors.

Child Study. Did this work provide you with opportunities for child study? What did the individual children say and do to show that they have a better understanding as to why living things make changes during autumn? Do the children show more interest in the great variety of seeds around them rather than being concerned with just the identification of plants and seeds? Do they understand a little better that seeds may be thought of as one way plants become adapted? Thus they may produce more plants of their kind.

Did you see any evidence of changing attitudes? Are children willing to observe changes in plants and animals outdoors? Are they willing to leave living things outdoors where they belong? In this way they show that they are accepting more responsibility for use of their environment. This may also mean that they are developing some feeling of the pattern of interrelationships of living things and their environment.

On your next trip outdoors observe the behavior of the children. Do they refrain from pulling parts of plants unless necessary? Are they willing to watch cocoons or chrysalises outdoors?

Are they making progress in stating hypotheses? Are they showing a willingness to check their statements by reading or by observing outdoors again or by experimenting? If they are learning to think along these lines, they are no doubt learning to use some elements of the scientific method or to think more objectively.

As you work with children, you may wish sometimes to evaluate their use of such new science words as autumn, leaf buds, chrysalis, and others. What is their concept of these words?

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Autumn on the Farm. (EBF) 1 reel, color. Two farm children observe the changes that take place in plant and animal life, as well as changes in recreation and work during the autumn.

Land of Real Believe. (Cornell) 1 reel, color and b/w. Spring, summer, autumn, and winter unfold in a beautiful and intriguing manner.

Monarch Butterfly. (IF) 1 reel, color. Shows the life cycle of a monarch butterfly from egg to adult, as well as its natural environment (Simmel-Meservey film).

Seed Dispersal. (EBF) 1 reel, b/w. Shows ways by which seeds get scattered, such as wind, animals, and propulsion from seed cases.

Filmstrips

Autumn in the Country. (CurrF) color.

In the Autumn. (YAF) color.

A Trip to the Autumn Woods. (SVE) color.

III · AIR, WATER, WEATHER

The seven-year-old has been reacting to air, water, and weather since infancy. From birth he responded to conditions necessary to his life, as warmth, water, and air, as well as others. His environment began with his skin and he reacted to wetness and dryness, warmth and cold.

From the time he could walk, the seven-year-old liked to paddle about in water, to feel the force of water on his hand as it came out of the faucet, to pour out water, to run into a small spray of water from a hose, and to play with inflated water wings. He made significant progress in becoming oriented to his environment with each birthday. However, he may be unable to state many meanings in words about his experiences.

Air, water, and weather are everyday experiences of children. They feel the wind pushing against themselves. They see airplanes flying in the air above them. Some children have traveled high above the ground. They shoot their paper airplanes through the air. Their pin wheels twirl in the air. They may have seen sailboats moving on water.

Children learn early that the weather influences what they may do. They hear weather predictions by radio and see them on television. They hear old sayings about predicting weather, too. They may have watched little figures pop in and out of some container supposedly to predict weather changes. Sometimes they are inclined to believe that this is magic or a trick. While children's explanations should be respected, you should help children learn to question magic as an explanation of events.

Children are curious about rainbows, and the shapes and colors of clouds. They may become fearful of streaks of lightning and the loud noise of thunder. Your explanations may help to dispel such fears.

Curiosity and imagination color children's explanations of such phenomena. But these qualities are present in making explanations and hypotheses, whether they come from a child or a scientist. You can help children to begin to check their imagination by asking such questions as: "How much of what you have said do you know to be true? How can we show that what you have said is true?"

SCIENCE MEANINGS

The following science meanings will help you to guide the children's thinking and to focus on the larger patterns or ideas of science, such as change, energy, and interrelationships:

Air is around you.
Clouds are in the air.

Dust is in the air.
Smoke is in the air.
Someday cities may be cleaner.
Water goes into the air.
Water comes out of the air.
Water comes from the air when it snows.
There are many uses for the thermometer.
A weather record shows changes in the air.
Heat makes ice melt. Water freezes.

INFORMATION FOR THE TEACHER

The Air Around Us. Air is all around us and fills every space that is not occupied by something else. Our earth is completely surrounded by air. Many everyday events and situations are explained in a large part by an understanding of the atmosphere. Some of these are ventilation, climate, weather, evaporation, condensation, rust, decay, living organisms, fire, aviation, respiration and other life processes, air pressure, and photosynthesis. Each of these situations is greatly affected by the surrounding air. Each situation points toward the larger pattern of interrelationships. Changes are continuously occurring in these situations, also.

What Is in the Air? The air is a mixture of several substances and they behave in different ways. The air around us is composed of about 21 per cent oxygen, 0.03 per cent carbon dioxide, 78 per cent nitrogen, and 0.94 per cent argon. There are small amounts of helium, neon, and other rare gases. Water vapor and dust are in the air, also.

Dust and Smoke in the Air. Wind blows over plowed fields or over places where plants are not growing. Dust gets into the air. Other solid dust particles come from tiny pieces of volcanic materials, dust from meteors, smoke, yeast cells, pollen, spores of plants, bacteria, or salt from the sea.

Smoke is made of very tiny particles of carbon. Forest fires in Canada and the United States may cause the air to be smoky over wide regions. Smoke from large factories and other sources make great problems in living conditions. People are constantly trying to cope with dirt from burning coal, oil, and other materials.

Although there are many disadvantages of smoke and dust, there are some advantages. Dust helps to make brilliant sunsets. Raindrops condense about dust. Some scientists believe that without dust there would be little or no rain.

Water Vapor in the Air. There are varying amounts of water in gaseous form in the air. Moisture is continuously evaporating into the air. Water vapor is invisible. It is an invisible gas.

Evaporation. Water in the air is constantly moving and changing. Water, like other substances, is composed of minute particles called molecules. They move fast and escape into the air from liquid surfaces or wet objects. These water molecules pass between the various kinds of molecules that make up the air. This flying off of the water molecules is evaporation and is the means by which water gets into the air.

Condensation. By heating water you get water vapor or steam. By cooling water vapor you get liquid water. The change of water vapor to liquid water is condensation. Warm air holds more moisture than cold air, and the warmer the air is, the more moisture it can hold. Air loses some of its moisture when it is cooled sufficiently. The air can hold only a certain amount of moisture at a given temperature.

When moist air is cooled to a point where it cannot hold all its moisture, below its saturation point, condensation occurs. Condensed water vapor falls to the earth from the atmosphere as rain or snow.

Fogs and Clouds. Water vapor condenses into tiny droplets of water when the temperature of the air is lowered. They collect in so great a number as to form fogs and clouds. Clouds and fogs are composed of tiny drops of condensed water vapor. Some droplets collect near the surface of the earth. This makes fog. Location makes the difference between a fog and a cloud. Fogs are at the surface of the earth while clouds are above the surface.

Cirrus clouds are often seen in fair weather. They are high, white, feathery clouds. Cirrus clouds are composed of ice crystals.

Cumulus clouds are the larger, white clouds with a flat base. They are fluffy masses often seen in fair summer weather. Some cumulus clouds accompany thunderstorms.

Sometimes you see low sheetlike clouds that cover the whole sky. These are stratus clouds. Nimbostratus are the black and dark gray clouds. These low-hanging clouds often bring rain or snow.

You need not feel responsible for teaching the clouds by types. Help the children to see the difference in the appearance of clouds and that the sky changes from time to time.

Weather. The state of the atmospheric conditions at any given time and place is described as weather. Climate refers to the general weather conditions over a larger geographic region. All kinds of weather in a given place help to make up its climate. These weather conditions over a long period of time produce its climate. Weather may change from day to day whereas climate changes only through a longer period of time, that is, many years.

WAYS OF WORKING WITH CHILDREN

Air is around you.
Clouds are in the air.

Pages 24-25. Air Around You

Discussing the Air Around You. Use the picture of Tom's garden on page 24 with a new emphasis. Read the labels Air over the garden, over the mountains, and high above the ground. Ask, "What places in the picture show us where air is?" Help the children to check their responses by reading page 24. Encourage them to name places where they think air is found around them.

Perhaps you will wish to explore the children's concept that air occupies space; that air is everywhere. Does their behavior show a willingness to accept or reject these ideas?

On page 25 introduce Betty to the children. Say that she lives far away from Tom. Ask, "Where is there air in Betty's city?" Use the illustration to discuss air over the city, trees, and streets; air that reaches high above ground and clouds. It is possible that there might be disagreements among children. In science children have a right to challenge and question the teacher, any adult, or each other. They should be encouraged to ask for reasons. Out of such disagreements you may state questions to guide the reading.

Developing Intelligent Behavior. Do the children question what they have read? Does anyone show signs of disbelief? Does anyone reject guessing or faulty thinking? It is stated that air is all around. How do we know that this is true? How can we test it? Does anyone show a willingness to experiment in order to check ideas? You may wish to encourage this kind of thinking throughout the use of Science Around You.

Checking Ideas. Help the children to try the following experiment to show that air is real; that it occupies space: Use a large paper box, such as a suit box or a hat box. In one end of the box cut a half-inch hole. Squeeze the sides of the box. Do you feel the air coming through the hole? How can you show that this is true? The air coming through the hole in the box will blow paper streamers, feathers, or a candle flame (as a safety precaution children should not handle matches or the lighted candle).

Dust is in the air.

Page 26. Dust in the Air

Discussing Dust in the Air. You may wish to watch for an opportunity to see dust in a stream of sunlight. Is there much dust around you? Where

does it come from? What can you do about the dust? You might ask: "What does Betty see in the air? What is Betty doing? Do you ever see dust in a stream of light?" Read the first two questions on page 26 and encourage the group to discuss how dust gets into the air around you.

Are the children aware of the sources of dust, such as plowed fields or gardens, smoke, pollen, salt spray from the sea, or ground surfaces without plants? Discuss the need to dust at school or home.

In using the second illustration on page 26 introduce Bill. Guide the discussion with questions, such as: "Is the air moving fast or slowly? How can you tell? Why is there dust all around?" Encourage the children to tell about their experiences with dust in the air.

While looking at the last picture on page 26, you might discuss the following: Grass is growing in this place; the wind is blowing, but no dust is blowing; grass holds the soil in place; and grass helps to keep the air clean. After responses from the children they might read the last paragraph to check their ideas. Watch to see if they seem to grasp the ideas between the wind blowing dust and cleaner air. Then they may be moving in the direction of a better understanding of the pattern of interrelationships.

Using Facts Learned. Could you look for uncovered spots on the ground around you? Do you see spots covered with grass around you? Does the grass help to hold the soil? Could you help the children to experiment with a small uncovered spot of ground by planting grass? Could you make a picture record (cold-water paints) of the spot before and after caring for it?

Smoke is in the air.
Someday cities may be cleaner.

Page 27. Smoke in the Air

Observing Smoke in the Air. Encourage children to look at chimneys in their community on their way to school. Do they tell of seeing much or little smoke coming from the chimneys? Is there a smoke problem where you live?

As the children look at the first illustration, help them to become aware of the smoke problems in many of our cities and towns.

You may wish to explain to your children that much smoke and soot around chimneys may indicate that the coal is not burning well; that not all the heat possible is being obtained from the coal.

Reading About Smoke in the Air. Check the children's observations by reading to answer questions, such as: "Where does the smoke go? What does the smoke do to a city? What must people do to clean? When shall we have clean cities?" Reread parts of the page to clarify ideas further if necessary. Do the children begin to grasp some of the

interrelationships between smoke and dust in the air and cleaner, healthier places in which to live?

Water goes into the air.
Water evaporates.

Pages 28-29. Water Goes into the Air

Stating a Problem and Hypothesis. As the children look at the picture on page 28, explain that Bob had poured a little water into the glass a few days ago. He has just discovered that the water is gone. Why? Help the children to speculate about what happened to the water. What explanations do they offer? Suggest that Bob thinks someone poured the water out. Read page 28 to find out what happened to the water. Ask: "What happened to the water in the glass? What do you think about Bob's suggestions to do the experiment again?"

Experimenting Again to Check. Do this experiment to be sure. Some children have a tendency to blame others for having done something when they cannot explain a scientific phenomenon. Here we are dealing with Bob's attitude and explanation that someone poured the water out of the glass. It shows Bob's willingness to try the experiment again, observing and making a new hypothesis. Encourage your children to check their conclusions by repeating an experiment.

Rejecting Guessing and Faulty Thinking. Guide the reading of the first two lines on page 29. Ask, "What do you think happened to the water?" On page 29 the conversation shows Mary's misconception and inaccurate hypothesis: "Maybe the glass leaks." Do your children agree or disagree with Mary? Bob makes a sound hypothesis: "Did it (water) go into the air?"

Here are illustrations of helping children to use elements of the scientific method in their thinking to build concepts about evaporation. When you help children to state hypotheses and test them by experimenting, you help them to use the elements of the scientific method.

Reading and Making Conclusions. Discuss the air around the glass in the picture at the top of page 29. Develop the following conclusions through discussion: There is air above, below, and all around the glass; you cannot see the air, but it can hold water; the air around Bob's glass contains water; the water from the glass evaporates into the air. Check the opinions expressed by the children by reading the last two paragraphs on page 29.

Help the children to answer the last question on page 29 from their own experiences. There are situations occurring in everyday life that may be used to give explanations. Some of these are: Wet clothing dries; water in paint jars evaporates; and some water in aquarium jars and water in a pet's

container goes into the air. This is the way to help children see common facts and to generalize from accumulated experiences. You are helping them to feel something about the patterns of interrelationships and change when they discover the meaning of evaporation.

There is water in the air.
You cannot see it.
Water comes out of the air.

Pages 30-31. Water Comes out of the Air

Giving Explanations and Interpretations. You may wish to introduce this experiment after you work with the concept that water goes into the air. It may follow children's questions, as: "What makes rain? What makes snow?" Or it may follow an observation or question about how water gets on the outside of a container on a warm day or in a warm room. Do your children develop other problems to be solved?

Notice the sequence in the illustrations on page 30. Betty is putting ice into the pitcher; there is no water on the outside. In the second illustration there is water on the pitcher. What explanations do children offer? Encourage and accept their explanations (hypotheses). Help them to state hypotheses. Does the water come from the inside because the pitcher leaks? Try the experiment to check their hypotheses. If your children express disbelief, are they willing to experiment (color water) to find out for themselves?

Checking Explanations by Reading. Help the children to grow in this way of checking their explanations and thinking. Use the question in the second paragraph on page 30, the children's comments, or other questions to guide their reading, as: "Where did the water on the pitcher come from? Do you think the air around the pitcher is warm? What did the cold pitcher do to the warm air around it? When did the water come out of the air? How do you know water comes out of the air?"

When air is cooled, some of the water comes out of the air.

Questioning Source of Water. On page 31 help the children to see what is in the jar. Note the water on the glass top. How did it get there? Guide their interpretation and reading with questions, such as: "Where does water in the jar come from? What does air do in the jar? What happens to the air near the top of the jar? What comes out of the air? How is the water in the jar used over and over again?"

Note such plants as the Christmas fern, wintergreen with red berries, a maple-tree seedling, moss and grass, decayed wood, and soil. It is not necessary for the children to identify any of the plants. Could your children have the experience of making a terrarium? Encourage them to choose

common, plentiful plants for it. They should not remove plants that are scarce. Use your terrarium to observe that water comes out of the air.

Making Conclusions. Betty states a conclusion based upon experiences and the facts in the second paragraph. Do your children agree or disagree? Your children may state conclusions in a slightly different way. Watch for and listen to their conclusions.

Some clouds are high in the air.
Some clouds are low in the air.

Page 32. Clouds in the Air

Seeing Many Kinds of Clouds. Help the children to see the sequence in the changing clouds on pages 32 and 33. Observe your sky conditions before reading page 32. Look at the clouds from your classroom windows if you cannot go outdoors. Are the clouds high in the air? What color are they? Are they low in the air? What color are they? What words do the children use to describe the clouds? Read page 32 for more information about clouds. You may wish to compose with the children an experience reading chart about your own observations of clouds. Do the children grasp the idea that clouds are different in size, shape, and color; and that they are constantly changing.

Painting Clouds You See. Perhaps you could provide opportunities for children to express their ideas with paints or colored chalk. It may take several days, of course, to see a variety of clouds.

Sometimes there is much water in the air.
Sometimes there is more water than the air can hold.

Page 33. Rain from the Air

Interpreting Changes in Clouds. You may wish to refer to the experiments and illustrations on pages 30 and 31 again. Use the illustrations on pages 32 and 33 in a sequence to show the changing clouds. Your children can easily see that the clouds have changed on page 33; that now it is raining; that the patrol boys are dressed for rainy weather; and that everything is wet.

Reading About Rain from the Air. In your children's discussions of the illustration listen for clues that may serve as purposes to guide the reading. You may wish to use questions, as: "When does water come out of the air? When do we have rain?"

Testing Facts by Experimenting. You may wish to demonstrate to your children how droplets of water appear on a cold plate. Children should be cautioned about the heat of steam; that they must not touch it. Explain that rain comes out of the air in much the same way. The warm air is pushed up.

It cools. Water comes out of the air to form clouds. Drops of water may fall as rain from clouds.

If you have an aquarium with a glass top, observe droplets of water on the glass top. Or, you might use a large jar with a glass plate over the mouth of the jar.

Do the children seem aware of the relationship between warm and cold air; that changes in the air cause water to come out of it? If so, they are moving in the direction of the larger patterns of change and interrelationships.

Water comes from the air when it snows.
It comes from water that you cannot see.

Page 34. Snow from the Air

Interpreting Facts About Snow. You may be using this chapter when there is no snow. Or, encourage the children to tell about their snow experiences; how cold the air was. If you live in a place where it snows, you might wish to use this page when it is snowing. Use the illustration as you discuss some of these facts, as: The falling snow comes from the air; there is water in air that you cannot see; it is there all the time; and this water freezes into snow.

Examining Similarities and Differences. Note how the children are catching snowflakes on black paper. Try this if you live where there is snow. Use a reading glass to help the children discover that a snowflake has six sides; that the tiny parts are unlike; and that all corners are alike. Can they catch a single snowflake to examine, rather than the larger ones which may be several combined? Snowflakes are often composed of a mass of crystals. Therefore, it is hard to distinguish any one of them. Care should be taken that children are dressed properly for outdoor study.

Avoiding Gullibility by Reading. Children should be guided to make new observations, to repeat experiments or observations, to consider new facts by reading, and to challenge conclusions. By nature children often act impulsively and talk freely. They need guidance in order to consider new ideas and to avoid being gullible or talking without facts or information.

The following questions, the children's, or your own will help to guide the reading of page 34: "When is there water in the air? How do you see water in the air? Can you always see water in the air? When does water sometimes freeze into snow?"

There are many uses for a thermometer.

Page 35. Warm Air and Cold Air

Interpreting Weather Conditions. Help the children to interpret the illustration, bringing out the use of an outdoor thermometer, the signs of cold weather, and the chart to show the relationship of clothing to temperature. Note that the teacher is helping Bob to read the thermometer.

Using and Reading About Thermometers. Use an outdoor thermometer if possible. You may wish to secure an outdoor-indoor thermometer. Encourage children to tell about thermometers they have seen or used. You may wish to help your children read a thermometer and learn more about appropriate clothing for changing weather. Thermometers should be large enough for markings to be seen easily and should be placed at the eye level of the children.[1] Read about thermometers on page 35.

A weather record shows changes in the air.

Pages 36-37. Watch the Weather About You; Make a Weather Record

These pages might be used at any time during the school year. The illustrations of a weather record on page 36 are intended for suggestions. Other symbols for recording changes in the weather might be devised by your group. The last three paragraphs on page 36 give clues for children to observe and discuss.

Recording Changes in Weather. The chart of the weather record on page 37 may be modified. It may be wise to have the children observe and record weather conditions for a short time and then stop. You might wish to return to this experience as dramatic changes occur during different seasons of the year.

Heat makes ice melt.
Water freezes.

Page 38. Ice and Snow Melt

Discussing Changes in Water. Use the first illustration to note that the sun is shining; the air is probably warmer because the snowman is melting; and that some snow has changed to water. Explain that heat makes ice and snow melt. Read page 38 to check ideas after the discussion.

In the second illustration help the children to note that the form of water has changed again. Try the experiment and help the children to describe this process of substances changing from one form to another.

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[1] A fourteen-inch thermometer with clear markings can be ordered from the Bauer Thermometer Company, 332 West 21st Street, New York City.

Page 39. What Is in the Air?

Reviewing Ideas. The experiments and other experiences on this page will make use of the facts developed in this chapter.

1. As the children watch and discuss the top of the jar, do they have an adequate concept that water comes out of the air?

2. Do the children show a willingness to test the idea of evaporation by experimenting? Can they vary factors in the experiment and state their conclusions?

3. Can the children give other evidence of evaporation of water into the air?

4. What do the children see in the air around them? Do they show some sensitivity to the amount of dust and smoke in the air?

MATERIALS NEEDED

The following materials were suggested in Science Around You:

- aquarium
- baking dish (shallow, oblong)
- bottle (quart)
- bowl (glass)
- glass cover (for aquarium)
- glass (for water)
- ice
- paper (black)
- pitcher (glass)
- plants (for terrarium)
- thermometer
- tin cup

The following materials were suggested in this Manual:

- baking dish (deep)
- bottles (2 large)
- box (large paper)
- candle
- containers or dishes (various shapes and sizes)
- cork stopper
- feather
- glass (flat 3" square or saucer)
- hot plate
- paints (cold-water)
- paper streamers
- reading glass
- straw (for drinking)
- teakettle
- tea strainer
- tumbler

FURTHER EXPERIENCES

These experiences may be used by children who need more firsthand experiences for reaching sound conclusions about air, water, and weather. Some children with special interests or abilities might have further experiences and record their experiments and observations.

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Showing How Fog Is Formed. Fill a large jar with hot water. Empty all except about one inch of the water. Place a tea strainer over the mouth of the jar. Fill it with ice cubes. Can your children predict where the fog will begin to form? Can they give explanations as to why the fog formed?

Fog forms as the warm, moist air comes in contact with the ice. Fog is composed of tiny droplets of condensed water vapor. It is at the top of the jar first but gradually fills it. Explain to the children that one kind of fog often occurs in much the same way. There may be fog when moist, warm air blows over the cold surface of our earth.

Sometimes fog forms near the surface of the earth. The ground cools off, but the air over it is warmer. Fog forms as the air is cooled by contact with the ground. Watch this happen by dropping ice into the bottom of the jar in the above experiment.

Showing How Air Occupies Space. Float a cork stopper on water in a deep baking dish. Invert a tumbler over the cork and push the tumbler down into the water. The tumbler does not fill with water. The cork stays on the level of the water. Tip the tumbler a little. The air comes out and the tumbler fills with water.

Showing That There Is Water in the Air; That Water Evaporates

a. Place equal amounts of water in several dishes or differently shaped containers. Observe for several days. More water disappears from some containers, due to surface difference, than from others.

b. Place equal amounts of water in two bottles. Put a stopper in one. Water does not escape from the bottle with the stopper.

c. Put equal amounts of water in containers of same size. Put one in a warm place, such as on or near the radiator. Place the second one in a cool, shady place. Heat makes evaporation take place faster.

These experiments will illustrate one principle of the scientific method to children. One factor was changed in each experiment. The varied factors were: (a) the exposure of the water to the air; (b) one bottle of water was exposed to the air and the other was not; (c) the temperature was varied.

Showing How Water Comes Out of the Air. Fill a shiny tin cup with colored ice water. Tiny drops of water soon appear on the outside of the cup. Does the tin cup leak? Where did this water come from? Children can see that the water outside the cup is not colored. The water on the cup comes out of the air. The air next to the cup cooled. Water in the air collected on the cup as it cooled.

Showing When Fire Produces Less Smoke. (For safety purposes, the teacher should perform this experiment while the children watch.) Light a

candle and pass a flat piece of glass about three inches square or a saucer through the upper part of the flame. Does the black on the glass look like smoke? Now place a straw near the flame and blow through it as you repeat the experiment. Little or no black forms on the plate. Fire produces less smoke when there is enough air.

Explaining Dust in the Air. There is usually dust when there is no rain. Is the ground dry around you because there has been no rain? Does the wind blow dust into the air? Does mother dust often? Where does the dust come from? Tell about dust storms where there is little rainfall.

EVALUATION

Child Study. Do you have some evidence that your children have improved ideas along the lines of such basic patterns as change or interrelationships? Do the children accept the fact that air is all around them? Can they explain how water comes out of the air and goes into the air? Are they more aware of the clouds changing in the sky? Do you see an increasing interest in air, water, and weather? Did you observe, in the spontaneous behavior of the children, their willingness to consider new ideas and to reject magic or superstition as explanations of events?

Did the children have an opportunity to use the following elements of the scientific method: Sensing and stating problems; giving explanations (hypotheses); improving their way of stating a hypothesis; checking an experiment by doing it again; checking facts by observing and by reading; and in making and stating conclusions?

What concepts have the children developed of such words as dust, smoke, dirty, weather, evaporates, high, low, cloud, melt, freezes, and thermometer?

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One Rainy Day. (Cor) 1 reel, color and b/w. Peggy watches a storm approaching during dry weather. She sees changes in wind and clouds. After the storm she sees a rainbow.
What Makes Rain. (YAF) 1 reel, b/w. Explains the concepts of evaporation and condensation as they apply to the water cycle.

Filmstrips

Weather. (YAF) color.
What Makes Rain. (YAF) b/w.

IV · OUR EARTH

Spatial concepts of the seven-year-old started in babyhood when he focused one eye on a fixed point. He could explore space a little further when he learned to co-ordinate both eyes. He increased his spatial sense. Then he learned to creep and walk from one room to another. Gradually language assisted him as he learned the meaning of such words as on and in, above and under, high and low, and up and down. At the age of three he knew where he was going. He might have been fearful of his own shadow. By the time he was five or six, he could make a simple map of a road which goes somewhere.

Now that he is seven, a child has some awareness of the earth's surface around him, of the moon, sun, and clouds. However, some seven-year-olds may have fears of high or unfamiliar places, of darkness or shadows, and other things. He may not feel sure about his own shadow. He is aware of other shadows but often cannot interpret them adequately for his own satisfaction.

Concepts about the earth of the seven-year-olds are expanding from home to faraway places. Many have had fathers, other members of the family, or friends go to faraway places on our earth. World events have made this true. Airplane flights around the world are common news. Faraway places on our earth seem relatively near through radio and television. Many children of this age have never known a world without television.

The seven-year-old is ready to follow a teacher's guidance. He may learn a few facts about sunshine and shadows, darkness, or unfamiliar places, enough to dispel his fears. He may think with great imagination about our earth. He may accept with confidence what he reads as being the best information available to him at the time.

Children of today are interested in space travel. They like to imagine a planet that is different from theirs. Perhaps this interest can be utilized to develop realistic ideas of the largeness of our earth.

SCIENCE MEANINGS

The following science meanings will help you to guide the growth and development of children's understanding of the large patterns or ideas of space, time, and interrelationships:

The earth is large as compared with a familiar neighborhood.
The earth is like a big ball.
There are many farms and cities on the earth.
The ground and ocean are part of the earth.
The air and clouds belong to the earth.
Our earth is round. It is like a very big ball.

The earth is a big moving ball. It is moving all the time.
The sun is shining somewhere at night.
Shadows are made when sunlight does not pass through objects.

INFORMATION FOR THE TEACHER

You will want to help your children start their conception of space early, rather than allow them to hold on to inaccurate and unscientific ideas. Their conceptions of space and their knowledge of the largeness of our earth will grow and grow after childhood.

Our Large Round Earth. Although the earth is large, it is small when compared with many other objects in the universe. The earth's diameter is about 8000 miles. While the earth seems like a great ball, it is not a perfect sphere. It is flattened at the poles. The diameter of the earth at the equator is twenty-six miles greater than its diameter from pole to pole.

Parts of the Earth. The earth is made up of three parts. These are the gaseous, liquid, and solid parts. The atmosphere is the gaseous part of the earth. The atmosphere is continuously wearing down the land and helping to move soil about. The solid part of our earth is composed of rocks and soil of various depths. Rocks have been pushed up from great depths. Oceans, rivers, lakes, ponds, water within the earth, and water in the atmosphere make up the liquid part of the earth. The oceans cover about three-fourths of the earth's surface. The liquid part does not exceed the solid part since the greatest depth of the ocean is only about six and a half miles deep.

Gravity. Gravity is the force that holds the atmosphere near the earth. People, buildings, plants, and animals are held to the surface of the earth by gravity.

Changes. There are great changes taking place on the earth all the time. The earth's surfaces rise and wear away through long periods of time. Climates of the earth have changed in the past and maybe are changing now. Living things on the earth have made great changes and adjustments. Others have not and have become extinct. Those living today have been more or less successful in making adaptations to changing conditions.

Our Earth Moves. The earth rotates on its axis every twenty-four hours causing day and night. It rotates from west to east in a counterclockwise movement. People in places east of a given point see the sun rising earlier. People gain an hour every 15 degrees of longitude while traveling westward around the world. People traveling eastward lose an hour every 15 degrees. There is an hour's difference in time for each 15 degrees of longitude.

Revolution. The earth revolves about the sun in a counterclockwise movement. The earth takes a year to revolve around the sun. The sun is also moving while the earth is revolving.

Movement. We do not feel the earth moving. The objects in space are far away and our earth does not pass them as it moves. All the objects on our earth rotate with us. Our earth moves smoothly, and we cannot notice any movement.

WAYS OF WORKING WITH CHILDREN

The earth is large as compared with a familiar neighborhood.

Pages 40-43. Our Large Earth

Looking Far Away. The authors urge you to take the children to a spot, such as a hilltop if you are in the country or to the top of a building if you are in the city. Help the children to see the succession of places or objects; that some are near; that some are far away; and that they are only a tiny part of our large earth. You will want to listen to the spontaneous comments made by the children. Spontaneous behavior may reveal questions, explanations, interpretations, and attitudes.

You might wish to use the illustration on page 40 to discuss the things that Jim can see. Note the order in which he may see them. Ask, "What does Jim see near him?" Do the children say that he sees the cows near the river; that beyond the river he sees the hills; that far away he sees other farms; that Jim can see far away; and that the farm is only a tiny part of the earth? Encourage your children to reveal their ideas of space.

Reading New Facts. Guide the reading in such a way that the children may see the objects in the order that Jim viewed them. Continue to discuss what is near; what is far away; and that the earth is large as compared with this one place. Should there be a difference of opinion, reread parts.

Painting What You See. Could your children make on the spot individual sketches of what they see nearby and far away on the outdoor trip to a hilltop or the top of a building? What children express should be accepted without much critical evaluation. If they should express misconceptions about the shape of trees, the sky and ground, rays of the sun, or other things, perhaps you might help them to look again. Such misconceptions will clear up in time.

A neighborhood in a city is only a tiny part of our large earth.

Interpreting Distance. For page 41 you may wish to use the illustration, experiences, and reading in ways similar to those for page 40. Do the children see the street and cars near Betty? Do they see that the lake comes next? Do they see that the trees in the park are beyond the lake; that part of

the city is beyond the park? Do they see the airplane high and far away? It will take many experiences to develop space concepts.

New words should be a part of the speaking vocabulary before children are expected to read them. Encourage your children to express through large pictures what they see nearby and far away. You are building a sensitivity to space around them, that this place is only a tiny part of the earth.

Estimating Time and Distance. It may help children to understand distance to discuss how long it takes to walk or to ride places. Such questions might be discussed as: "How long does it take you to walk to school? How many blocks do you walk to school? Or do you ride to school? How long does it take? How far is it to school?" Encourage your children to express their ideas freely.

The children might discuss places they have visited. You might ask, "How long did it take to get there?" This will help to develop time and space relationships. If a child has gone on a fairly long overnight trip, he might explain what took place, such as the number of meals on the train, going to bed, and seeing rivers, mountains, oceans, plains, prairies, and cities. The distance traveled, if known, might be compared with the total distance around the earth. It takes a longer time to go around the earth.

The earth is like a big ball.
There are many farms and cities on the earth.
There are many people on the earth.

Using a Globe. As you look at the illustrations on pages 42 and 43, explain to the children that these are pictures of our earth. You may wish to tell your children that these pictures of the earth are as one far away from the earth might see it. What seems to be their thinking about the size of the earth? It must be remembered that the conception of space will enlarge as they grow older.

Use a globe, telling the children that it is somewhat like a map of our round earth. Locate approximately where they live on the globe. Point out other places which they have heard about. Put small pieces of plasticine or clay on the globe for Jim's farm and Betty's city and where the children live. Note what a tiny part of the whole globe they are; that there are many, many farms and cities on our earth. There are many people on these farms and in these cities. How many children are in their school? About how many people live in their neighborhood, town, or city?

Reading to Check Ideas. Questions from children, disagreements, and misconceptions should not be discouraged. Rather, they may be used to give purpose for reading page 42.

Recording Facts. After using the illustration, having discussion, reading, and other experiences, you may wish to help your children to compose as a group a story similar to the one on page 42.

> OUR EARTH
>
> Our town is part of the earth.
> The biggest city is a part of the earth.
> The farm near us is a tiny part of the earth.
> There are many cities and farms on the earth.
> Many, many people live on the earth.

The ground and ocean are part of the earth.
The air and clouds belong to the earth.

Expanding Ideas About Space. Find the labels Air, Clouds, Ocean, and Ground on the sphere illustrated on page 43. Talk about the ground and ocean being a part of the earth. Have the children seen or traveled on an ocean? Can they tell about the experience? How many days and nights did the trip take?

Talk about the air and clouds belonging to the earth. Has anyone traveled in the air? How many hours was the trip? How long is it by train or car for the same trip? What could they see? Has anyone heard an airplane above the clouds but could not see it?

Help the children to discuss other things around them that belong to the earth, such as rivers, mountains, caves, gullies, brooks, plants, and animals.

Our earth is like a very big ball.

Pages 44-45. Our Earth Is Round

Discussing the Shape of Our Earth. Encourage your children to give their interpretation of the shape of our earth. Ask: "What makes you think that? What are your reasons for what you say?" Use the double-spread illustration on pages 44 and 45. Which are the land parts? Which are the water parts?

Help the children to find the land and water parts on a globe. Explain that our earth is round and somewhat like the globe. Using a globe ask: "Where would you ride on land? Where would you ride on a ship?"

Introduce Betty's trip that has been on the land, on the water, and in the air. Point out on page 45 where Betty used to live. Do the children see the train on which Betty began her trip? Do they see the ship on which she traveled across the ocean to the United States? Note on page 44 the airplane and car in which Betty traveled after she left the ship. Ask: "Would she have to leave our earth? Do you think that these places are far apart?" Read pages 44 and 45 to find out for sure. Try not to feel too hurried. Think of reading as reading and discussion.

The earth is a big moving ball.
It is moving all the time.

Pages 46-47. Our Earth Moves

Sensing Questions or Problems. Do the children show an inquiring attitude as they interpret the illustration on pages 46 and 47? Does the earth move? Does it stand still? In what ways does the picture of the earth, its shadow, and the immense sky contribute to their concept of space?

As the children read page 46, they may ask again and again: "How do we know the earth is moving? Why don't we feel the earth moving?" That the earth is giving them a ride may be amusing. Encourage them to name anything else that is getting a ride on the earth.

As you discuss the ideas on page 47, see if the children remember passing nearby objects, such as trees, telephone poles, and houses, while riding. We seem to pass more distant objects, as a house, more slowly. But objects out in space are so far away that we cannot pass them. The earth does not pass them.

Some children may grasp such ideas as: The earth moves smoothly; it does not turn sharp corners; it does not slow down for stop lights; it does not run over rough roads; it never starts and stops; it keeps on moving all the time.

Think of children's concepts of space as a kind of behavior. Behavior is revealed in what they say and do. Do they accept the ideas developed on pages 46 and 47?

The sun is shining somewhere at night.

Page 48. Night and Day on Our Earth

Discussing Night and Day. Use the picture of the earth to show night and day. Have the children point to the day side of the picture first. Then point to the night side. Check to see if they have this correct. Note the color of the sunshine on Jim's farm on the day side of the picture.

Experimenting to Clarify Ideas. Some children may say, "The sun is not shining at night." You may wish to use a bright light (flashlight) with a globe to show the relationship between the moving (rotating) earth and the succession of day and night. Do the children accept the fact that the sun is not shining on us at night? Explain that it is shining somewhere at night; it shines on the other side of the earth; there are other people who have day when we have night; some people sleep while we work; and some people work while we sleep; but the sun is always shining somewhere.

Reading to Check Ideas. Guide the reading with questions, as: "When does Jim's farm have sunlight? When does it have night?" Reread if necessary to clarify ideas.

Shadows are made when sunlight does not pass through objects.

Page 49. Sunlight and Shadows

Experimenting with Sunlight. Use the illustration to determine the materials you will need in this experiment. The illustration shows you how to use these materials. You might ask: "What makes the shadow? Why does the glass not make a shadow?" What hypotheses do the children make?

Reading to Check Conclusions. After the children have experimented, they might read page 49 to check their own experimenting. Help them to formulate some conclusions. Their facts will be needed on the next two pages.

Sometimes we see shadows.
Something stops the light.

Page 50. Making Shadows

Experimenting with Shadows. The illustration suggests the materials needed for making a shadow play or for guess-who games. These are a large piece of cloth like a sheet and a source of light.

Reading to Check Experiments. Read the first four sentences on page 50. Encourage the children to discover by experimenting where they should stand and where the light should be. Of course, they stand between the light and the curtain. Their bodies stop the light. Help the children to check their own conclusions by reading the last two sentences on page 50.

Page 51. Thinking About Our Earth

Reviewing Ideas. You may wish to use page 51 to help your children evaluate progress made in using this chapter. This will enable them to reuse in some new situations the facts learned.

Discuss the illustration at the top of page 51. Read and discuss the questions: "What stops the sunlight? What makes the shadows?"

Go outdoors on a sunny day and look for shadows. Do the children observe any differences in shadows, as to length of shadows, the direction in which the shadows fall, or the time of year? Do not expect the children's concepts to be very clear about shadows outdoors. They will need many experiences, discussions, and explanations.

MATERIALS NEEDED

Materials suggested for use in Science Around You:

cloth (a sheet)
clothespins
cord
electric light
glass (flat, smooth, square, such as windowpane)

Materials suggested for use in this Manual:

clay or plasticine
flashlight
globe (stand, axis)
paints
paper (for sketches)
paper (large for shadows)
scissors
strips of paper

FURTHER EXPERIENCES

These experiences may help you to care for individual differences among your children. Some children may need additional experiences before being able to make sound conclusions. Other children, the faster learning ones, may use these experiences to extend and enlarge their present understanding. These children should be encouraged to give reasons for their statements and, when possible, to share their experimentation and observations with other members of the group.

Showing the Distance Around the Globe. The distance covered by a child while traveling might be measured by placing a strip of paper between two points. Use another strip of paper to measure the distance around the globe. Put these two strips of paper on a chart. Captions might be used with the correct strips, such as:

. . . . . .
This is how far Mary went.

. . . . . .
This is how far it is around the earth.

Finding Out How the Earth Moves. Tell the children that their globe stands for the earth. Turn the globe on its axis to illustrate the manner in which the earth rotates. You may wish to use a flashlight shining on one place to develop the relationship between the earth moving (rotating) and the succession of day and night.

You may wish to have a child stand and turn around and around in the way he thinks the earth rotates. Whether you should add a sun child and let the earth child rotate and move around the sun child, depends upon the interest

and maturity of your children. It is not the purpose of the authors to go into the causes of day and night at this level.

Making Shadows. Shadows are made when sunshine does not pass through objects. A further study of shadows might begin with observing shadows of trees, buildings, people, or other objects. You might wish to have large pieces of paper ready when the children arrive at school. Have a child stand so that his shadow falls on the paper. Trace around the shadow and then cut it out. This shadow will be long. At noontime make another shadow of the same child, and again at the close of day. The papers representing the shadows will be of different lengths. The longest shadow was made when the sun was lowest in the sky, the shortest when it was highest. The shadow made in the afternoon fell in the opposite direction from the shadow in the morning.

You may wish to try this experience during different seasons. Do children make predictions and test to see if they are accurate? The low sun of winter makes a long shadow, while the higher sun of late spring makes a shorter shadow. Long shadows may be connected with coolness, while short ones may be related to warmth.

EVALUATION

In this chapter you may have helped your children to think more seriously about the vastness of our earth in the universe. Do they seem willing to consider new and reliable information and ideas? Are they growing in their ability to think in terms of space and time?

Do the children get the idea that things may seem big at times and small at other times, depending upon what they were comparing? Do they accept the idea that the earth is small when compared with the sun; that the earth is large when compared with a city? Did you observe any fears, misconceptions, or changing attitudes? Do they seem to have confidence in what was read in this chapter?

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Film

Our Big, Round World. (Cor) 1 reel, b/w and color. If children are well prepared to see this film, appropriate parts will show them our moving earth, light from the sun, the changing seasons, and how some people will have daylight while others do not.

V · THE SKY

Gradually the seven-year-old is becoming more aware of changes in the sky. From play-pen days he has soaked up hours of sunshine. Everyone knew his reactions when he was too hot and cross. As time passed, he wished for sunshine after several rainy days and inquired, "When will the sun shine again?" He learned his reactions. He made interpretations.

Sometime, somewhere, the seven-year-old heard stories of the man in the moon. If he asked, "Is it true?" someone may have helped him to distinguish between fantasy and truth. About the time he started to school, his life-space expanded. That is, he moved about with greater independence. He walked or rode to school. He knew more people. Common objects had more meaning as he touched, saw, listened, tasted, or smelled them. Experience increased. He may have been puzzled by seeing the moon in the day sky as he walked to school. He soon gave his attention to space travel. Through movies, television, or travel he is becoming acquainted with our universe.

You may hear some misconceptions of the children while using this chapter in Science Around You. Some common misconceptions held by children are: "The sun is not shining at night." "The sun is smaller than our earth." "The sun goes around the earth." "It is cloudy. The sun is not shining." Children are familiar with the common saying, "The sun rises and sets."

The authors know that young children cannot grasp a very complex concept of the true size of the earth, sun, and moon. They know that the child looks about him and sees what seems to be a large earth. The sun and stars look small by comparison. They look smaller than nearby trees, houses, and buildings. They look smaller than mountains, farms, and cities.

However, most children are curious and imaginative. They will listen and accept as their own some of the true facts that you know and tell them about our universe. They will come to have confidence in information given to them through teachers and parents or by reading materials.

SCIENCE MEANINGS

Use this chapter to help the children have confidence in and rely on accurate information. The following science meanings will help you to focus attention on certain concepts of the large patterns of space, energy, change, and interrelationships:

The sun is far away.
The sun is so hot it gives off light.

The sun looks small but it is very large.
We see the sun rising in the east and setting in the west.
The sun shines all the time.
The moon is smaller than the earth or sun.
The moon gives us light.
Sometimes we see the moon in the day sky.
Sometimes we see a whole, round moon.
The clouds in the sky change.

INFORMATION FOR THE TEACHER

Our Sun Is Far Away. Our sun seems small because it is so far away. Our earth is about 93,000,000 miles away from the sun. The sun is approximately 3,000,000 miles nearer the earth on January 1 than on July 1. This is a short distance as compared with the total distance from the sun. It is, of course, unnecessary to use any of these large numbers with young children.

Our Sun Is Large. The diameter of our earth is about 8000 miles. The diameter of the sun is 109 times the earth's diameter. Our sun is just an average-sized star. It is an average star in several ways, such as in color, brightness, age, and size. Some stars are brighter, older, and larger than our sun. Some stars are less bright, not as old, and less in size than our sun. The stars are suns and our sun is a star. Such facts help us to get a more accurate conception of space.

The Sun Shines All the Time. The sun shines all the time and gives off light and heat in all directions. When the sun shines on us, the other half of the earth is in darkness. When we have night, the sun is shining on another part of the earth. We are in the shadow of the earth at night.

We often say that the sun is not shining on a cloudy day. The sun is shining far out beyond the clouds. The clouds make a shadow over the ground. We are in the shadow made by the clouds. The clouds stop the light.

The Sun Is Hot. Our sun has a temperature at the surface of about 10,000 degrees Fahrenheit. The temperature of the inner part of the sun is much, much hotter. Some stars are hotter than our sun. It is believed that the temperature inside some stars may be as much as 18,000,000 degrees Fahrenheit. The sun is not just a ball of burning gases with flames. Its immense heat is not due to burning. The causes of the sun's heat are not fully known. As changes take place in the sun, a large amount of light, heat, and other forms of energy are given off.

The Earth's Moon. Next to the sun the earth's moon is the most noticeable object in the sky. This moon is the nearest body to the earth. Sometimes it is 222,000 miles from the earth. Sometimes its distance is as much as 253,000 miles from the earth. The diameter of the moon is about 2000 miles.

Moonlight is reflected light from the sun. The moon is not a source of light. It is seen by reflected light. The stars shine by their own light.

The Moon Revolves About the Earth. The moon seems to rise and set because of the rotation of the earth. The sun and stars seem to do the same. The moon is the only body to move around the earth. It does this in about twenty-seven and a half days or a little less than a month. It rises and sets about fifty-one minutes later each day. This is a result of the revolution of the moon about the earth.

Stars. Stars are suns. They shine by their own light. There are many stars larger than our sun; some are smaller than our sun. Some stars are hotter than our sun while others are cooler. A large star may appear small because it is so far away. Stars are all around the earth. They are in the sky during the daytime but we cannot see them because the sun is so bright.

Sometimes stars seem to twinkle and to have fixed points. This, of course, is not true. The movement of the air above us seems to cause the fluctuation in the brightness of a star.

WAYS OF WORKING WITH CHILDREN

The sun is far away from our earth.

Page 52. The Sun Is Far Away

Correcting Misconceptions. What comments do your children make while studying the illustration on pages 52 and 53? Does anyone say that the sun or stars are smaller than our earth? Do the children say that they look smaller than nearby trees, houses, mountains, farms, or cities? Such proposals are incorrect, but they have merit if one views the child's learning as one of growth in interpreting the environment.

Rejecting Guessing. While children must have freedom for discussion, they need help in the process of getting the best statement of truth available. You may help them to reject guessing or faulty thinking with such questions as: "How do we know that this is true? What reasons can you give for what you say? How may we be sure? How may we find out?" Perhaps the children will question one another or others if you encourage them to ask for reasons.

Guide the children's interpretation by referring to the illustration again. Note that only a small part of the sun is shown on page 53; how much smaller the earth looks than the sun; and that the sun is far away from the earth. Explain that the sun seems small because it is so far, far away. Could you help the children to formulate a question or two?

Seeking Reliable Facts. Now read page 52 to check their ideas about the distance from the earth to the sun; that it is not a part of our earth. Children do not discover new facts, such as the ones in this selection, for society. However, they may discover these new facts for themselves.

Explain to your children that books can help us to answer questions; that we don't have to guess about things. Thus you can help children to have confidence in some books as well as in scientists who discover new facts.

The sun is so hot it gives off light.

Page 53. The Sun Is Hot

Discussion and Reading. Encourage the children to tell of their own experiences with the sun's heat and light, as a severe sunburn, plants wilting in a garden, how hot a desert is, glare from the sun, or light from it. Bring out facts in the discussion before reading page 53. You might wish to list some of their ideas on the blackboard. Then you might suggest: "Let's read page 53 to see if our ideas agree with this selection. What fact did you read that we did not mention?" Do they agree or disagree with the facts stated?

The sun looks small but is very large.
We see the sun rising in the east.

Pages 54-55. The Morning Sun; The Afternoon Sun

Listening to Explanations. Introduce "The Morning Sun" on page 54 to the children; explain that this is Mary's farm. Ask, "Where do you see the sun in the sky early in the morning at your house?" Now read to find how it looks to Mary. Do your children agree or disagree with Mary? Note the questions directed to the children in the text. Take time to get their responses. Ask: "Why do you think it is morning here? In which direction is the sun rising?" Note that the labels in the illustration read East and West. Ask: "Where is the sun coming up? How does the sun look to you?" Your children may say what Mary did; that the sun looks smaller than the hill, house, and trees.

Finding Directions. You may wish to explain to a child that when he faces the morning sun, he is facing east and the west is behind him. If he raises his arms horizontally, the left arm will point to the north and the right arm to the south. When he looks at the late afternoon sun, he is facing the west and the east is behind him. If his arms are now raised horizontally, the right arm will point to the north and the left arm to the south. Could your children try this?

We see the sun setting in the west.

Accepting Explanations. Did the children question what is meant by "comes up" on page 54? If not, should you question them? What does "going down" mean? Actually the earth rotates on its axis. The sun does not "rise" and "set". This is a common expression, however. The sun does not move from the east to the west as it appears to do. The rotation of the earth from west to east makes the sun appear to rise and set.

On page 55 have the children note the position of the sun now. Read the labels West and East. Ask: "Where do you see the sun in the sky early in the afternoon at your house? Does it look small or large to you in comparison with buildings and trees? Where do you see the sun later in the afternoon?" Note the elements in the illustration on page 55 similar to those on page 54 and the opposite direction of the setting sun.

Evaluating Facts. Perhaps you might ask your children: "Where does Mary see the sun now? Do you agree or disagree with Mary? Is the sun as small as Mary thinks?" Read page 55 and discuss whether you think the sun is so small. What conclusions do the children reach?

The sun looks smaller than the earth but it is much larger.

Page 56. The Sun Is Large

Interpreting the Size of the Sun. Encourage the children to discuss how much larger the sun is than farms, lakes, cities, the moon, and the earth. Use the illustration to help point out how much larger the sun is than the moon; that this page is not nearly large enough to show the true size of the sun. Suggest that they read to check their ideas with the facts on page 56. Review and reread page 52 telling that the sun is far away; it looks small because it is so far away.

Testing Distance and Size. A child might hold a piece of chalk or a small ball or other objects close to the children and gradually move away from them. Measure the distance with a yardstick. Does the chalk look smaller than it did when viewed close up? Does it really become smaller? Try several objects. This experience will be more effective if done outdoors where a greater variation in distance might be obtained.

Could the sun provide us with so much heat and light if it were as small as it appears to be? Help your children to reach and state conclusions from their own experiences about the fact that distance affects the appearance of objects. The children might easily get the idea by watching a car approach from far down the street or road, or by watching an airplane flying high in the sky.

The sun shines on cloudy days.

Page 57. The Sun Is Shining All the Time

Correcting Misconceptions. Do your children state any misconceptions about the sun not shining all the time. What reasons do they give for their explanations? Use the picture, helping them to bring out the fact that it is raining, it is cloudy, but the sun is shining above the rain cloud. Note the sun above the clouds. Should there be some disagreement among the children, see who is right by reading the first paragraph on page 57.

Look at the airplane in the illustration. Is it flying above the clouds? Can Mary see the airplane? Now read the second paragraph to find where the airplane is flying. Have the children tell of experiences similar to Mary's.

From the use of illustrations, reading, and their own experiences, children should be helped to reach conclusions, as: The sun is shining on cloudy and sunny days; it shines all the time; and airplanes fly in the sunshine above clouds.

Adults, as well as children, often say on a rainy day, "The sun is not shining today." Children interpret this literally and thus build up a misconception. Remember that mankind required centuries of study to learn about the universe as we know it today; that we may learn much more about the universe in our world of tomorrow.

Experimenting to Show Reasons. The fact that the sun is shining somewhere all the time may be shown by using a flashlight and a globe. Place a pin in the globe at approximately the place where the children live. Shine the light on the globe and slowly turn the globe in a counterclockwise direction. While one part of the earth is turning into sunlight, another part is turning out of it. One-half the earth is always lighted. Encourage the children to question the accuracy of the demonstration as to sizes and distance.

The moon is smaller than the earth or sun.
The moon gives us light.
Sometimes we see a whole moon.

Pages 58-59. The Night Sky

Observing the Moon in the Night Sky. On page 58 this large, beautiful moon will no doubt cause the children to talk about the moon as they have observed it in the night sky. Have they seen the moon when it looked like this? Discuss the moon's color, shape, and size. Refer to page 52 if there is doubt about the size of the moon in relation to the sun. Note the concepts of size that your children express.

Will children accept the fact if you tell them that the moon's light is reflected from the sun? It has no light of its own. Show and discuss what

reflect means. Help the children develop ideas of reflection, as: Reflections in each other's eyes, reflections of building or trees on water, reflections in a mirror, on a large piece of glass, or on some other shiny surface.

Encourage the children to tell of nights when they saw a large, round moon, as: When playing outdoors, in seeing moonlight from a bedroom window, or seeing shadows at night.

Sometimes we do not see a moon in the night sky.
Sometimes we see the moon in the day sky.

On page 59 contrast the night sky with that on page 58. Do the children see the stars but no moon? Can they tell about nights when there was no moonlight in the night sky?

Have the children seen the moon in the sky as they walked to school? Why does it look less bright in the daytime than at night? Compare the color of the moon in the last illustration on page 59 with its color on page 58.

Sometimes there are tiny white clouds high in the sky.

Pages 60-62. Clouds in the Sky

Watching Clouds Change. Use these four illustrations to show in a sequence how the clouds in the sky change. On page 60 help the children to see the tiny, fluffy white clouds in the blue sky. Note that it may be a good day for sailing or fishing. Ask: "What kind of weather do we have when we see tiny white clouds? After you read the first sentences, look at your sky. Are your clouds like those in the second paragraph? Read to find out for sure." The last two questions on page 60 will guide another observation of your sky or will help you to go to the illustration on page 61.

Sometimes there are black clouds low in the sky.

Use the illustration on page 61 by asking, "What is happening in the sky now?" Note the same setting as in the illustration on page 60. Ask: "Are the clouds in the sky changing? What makes you think so?" Note the wind in the sails, that the clouds are larger, that some are blacker, that the wind is moving the trees, and the sailboat seems to be returning to land. "Do you think the clouds are moving? What makes the clouds move? What kind of clouds do you see now in the illustration? Read page 61 to check your ideas."

Rain comes from the big dark clouds.
The clouds in the sky change.

In the illustration at the top of page 62 note: The same setting as in the preceding illustrations, the low black clouds, the wind, and the father and boy

dressed for rain. Ask: "How have the clouds changed? What do you think the weather is like?" Read the first paragraph to check the kind of clouds you see in the illustration.

In the second illustration on page 62 note the changing sky conditions. Read to find out what happened to the low rain clouds.

The clouds in the sky change.

Page 63. Watching the Sky

Painting Clouds You See. Do your children show more signs of interest in the changing sky? From time to time you may help your children plan a picture record of changes they see in the sky. Their pictures may reveal the facts they really know about changing sky conditions. They might show the sequence of changes in the clouds for several days. Colored chalk is easy for children to use outdoors.

Reading Directions. The illustration and text will give you and your children clues for observing changing conditions of your sky. The questions in the second paragraph are suggestive for planning what to look for. Could your children add others? Perhaps you might wish to help your children to compose appropriate captions for their pictures.

MATERIALS NEEDED

Materials suggested for use in this Manual:

ball	globe (stand, axis)
button	metal (tin, nickel, copper)
chalk (colored)	paints and paper
electric light	plants in flowerpots (2)
flashlight	yardstick

FURTHER EXPERIENCES

You will probably find a wide range in individual differences among your children. Interests vary. Some children may need further discussion and experiences to grasp some of the science meanings about space as developed in this chapter. Others may use further activities to show their reasons for believing certain facts to be true. Watch the contributions of individual children during the discussions of these experiences.

Showing That the Sun Is Much Larger Than the Earth. Draw an arc of a large circle in the corner of the blackboard to represent the sun. If the arc were finished, it would be larger than the classroom. At the other end of the blackboard draw a small circle about half an inch in diameter. Help

the children to reach conclusions, such as: The sun is larger than the earth; it is larger than many earths put together.

Have your children had experience with counting and measuring with a yardstick? If so, a few may show other children this experience. Draw a circle outdoors about $1\frac{1}{2}$ yards wide (diameter). This circle will represent the sun. About $13\frac{1}{2}$ yards away from the sun circle, place a button about $\frac{1}{2}$ inch wide (diameter). This will show a fairly good relationship between the sun and the earth both as to size and distance.

Showing That Objects Receive Heat from the Sun. Objects receive heat from the sun. Place various metal objects (tin, nickel, copper, etc.) in sunlight and in shade. Which feel warm? Which feel cool? Those in the sunlight will feel much warmer to touch than those in the shade.

Experimenting to Show That Plants Need Sunlight. Show that green plants need sunlight by placing one of two similar plants in the sunlight and the other in darkness. Water both plants. The plant in sunlight will grow well, whereas the one in darkness will be stunted.

Experimenting to See How Distance Affects the Appearance of Objects. Show the brightness of light on a piece of paper that is held close to a small light. Compare this with the same paper when it is held far away from the light.

Discussing Heat and Light from the Sun. The earth receives little of the sun's total heat. Place a ball in one corner of the room. Place a light, such as an electric light, in the opposite part of the room. Point out how the light gives off heat and light in all directions. How much of the heat and light is received by the ball?

EVALUATION

Do science experiences give you opportunities for child study? Do you see evidence that the children have enlarged their concepts of the basic patterns of space, energy, change, and interrelationships? Do they accept such facts as: The sun looks smaller than the earth but it is larger; the sun shines all the time; and the sky changes?

In what ways did you notice the behavior of the children changing? Do they respect the ideas of one another? Did you note some misconceptions held by the children? What sources and reasons did they offer for their beliefs? In your discussions did you notice some children rejecting guessing and faulty thinking? Did you notice a willingness to read for facts? Were they critical of the selection? Did they seem to accept your explanations and interpretations? Do they challenge any of your statements? Children should feel free to express themselves. They should never be humiliated because of ignorance or mistakes or questions.

What concept do your children have of the following words: larger, smaller, east, west, high, low, cloudy and clouds?

BIBLIOGRAPHY

For the Teacher

Craig, Gerald S. Science for the Elementary-School Teacher, pp. 49-81. Ginn and Company, 1947.

Greenlee, Julian. Teaching Science to Children, pp. 37-43. Wm. C. Brown and Company, 1951.

For the Children

Schneider, Herman and Nina. You Among the Stars. William R. Scott, Inc., 1951. Some of the illustrations and a few selections about the sun, moon, and stars may be useful.

Films

Sun, Earth, and Moon. (A1F) 1 reel, b/w. Children must be prepared to see this film. Parts of it will, however, contribute to their idea of space, moving bodies, and heat and light from the sun.

The Sun's Family. (YAF) 1 reel, b/w. Explains what the solar system is.

This Is the Moon. (YAF) 1 reel, b/w. Explains the relation of the moon to the sun and the earth.

Filmstrip

The Moon. (YAF) color.

VI · WINTER

Many children using Science Around You will live in the north temperate region. In the chapter on "Winter," Mary lives in such a place. These places have many dramatic changes in winter. Children who live in similar places know that days are now shorter and that nights are longer. They play in snow. They watch snow machines at work. They skate and ride sleds on ice.

In the winter these children see less of some animals that are around during other seasons. They may know that certain animals are not around at all in winter. But what happens to those animals? Where do they go? How do some animals manage to live during cold snowy weather? What changes are made by them in order to live through cold wintry seasons?

Children may see brown-looking grass in winter and may say that it is dead. Some plants that they see in summer die and have to be replanted each year. Certain plants that they see do not have to be replanted each year but will grow again in the spring. Such plants often grow regardless of a hard winter. Children see evergreens in winter. How do they change? When do they get new leaves?

Children who live in cold winter places may go with their parents to warm winter places. Within a few hours they may travel to a warmer place. Days are longer. Nights are shorter. Clothing is different. Seasons are different in these warm winter places. These children may visit warm winter places like Sandy's in Science Around You.

All these everyday observations of the environment offer rich opportunities for further interpretation with children. However, children need teachers who will listen to their explanations, who will challenge their thinking and reasoning, who will help them to obtain more adequate concepts of their changing seasons.

Many, many children who will be using Science Around You may say, "Our winter is not like Mary's." Many of these children will never have seen snow nor skated on ice. They swim outdoors when children in other regions play in snow. They gather fruits and vegetables. They play outdoors about as long at one time during the year as they do at another time. They know that many people spend their winter vacations at this warm place to escape the cold in their own home region.

These children may know that they have some kinds of birds during their warm winter days that they do not see during their summers. Some children will say that where they live is somewhat like Sandy's place in Science Around You.

Thus children in many regions may begin to see that seasons mean different conditions in different places. Since there are such wide variations in seasonal changes throughout the United States and Canada, children should begin to see that their place may be unlike places somewhere else.

SCIENCE MEANINGS

Wherever children are living, there are changes taking place in living things around them. Wherever children are using Science Around You, you can help them to become more skillful in observing changes in their immediate environment. At present you may help them to enlarge their concepts of changes they see nearby. Later these same concepts will enlarge, and they will see greater relationships between living things in their environment.

The following ideas about Mary's place (in the north temperate region) and Sandy's place (a warmer region) will help you to focus your work on the growth and development of the larger patterns or principles of conditions necessary for life, variety, adaptation, and change:

In some places there are many changes during a year. (Mary's place)
In some places there are few changes during a year. (Sandy's place)
Some animals stay about all the year. Changes are made by animals.
Some animals hibernate for a part of or all winter.
Some birds travel longer distances than others.
Some plants live all winter. Changes are made by plants.

INFORMATION FOR THE TEACHER

Changes in the Winter. You may wish to read in this Manual the section addressed to the teacher in the chapter on "Autumn" for more information about changes in winter. While writing the chapter on autumn in a north temperate region, the authors developed changes made by some plants, migration of animals, and changes made by some insects.

Partial Hibernators. Some animals find a place to stay on cold wintry days. These animals may have difficulty in finding food during the winter. Skunks, raccoons, and chipmunks may hibernate during cold weather. Then they come out and look for food on warm sunny days. Squirrels, muskrats, and meadow mice come out on warm days looking for food, also.

All these animals eat and eat before winter comes and grow very fat. Their energy comes from the stored fat within their bodies. Chipmunks and squirrels eat nuts they have stored during the autumn. They eat when they can find food. Chipmunks store nuts in one room of their underground homes. These places are well below the frost line and the frozen ground. During this period underground the blood in these animals does not freeze.

Some Animals Hibernate All Winter. Woodchucks, frogs, toads, turtles, and snakes are some of the animals that hibernate all winter. Some frogs and toads go into the mud at the bottom of a pond. Many turtles go into mud or sand at the edge of streams. Some snakes go under rocks, into caves, or decayed logs. Woodchucks dig into the ground below the frost line or frozen ground. These animals stay underground all winter.

These animals undergo great changes while hibernating. They do not see, hear, smell, or seem to feel while in this state. Breathing is very slow. Their heartbeat is very feeble. Most of these animals exist in this state all winter. They come out thin and hungry when it is warmer in the spring.

Many animals in the north temperate region show how adaptations to adverse conditions of low temperatures and scarcity of food are made in their environment by hibernating. Hibernation is not fully understood by scientists.

WAYS OF WORKING WITH CHILDREN

Pages 64-65. Cold Winter Days

Winters are cold in some places.
In some places there are many changes.

Interpreting Winter Conditions. You might wish to make a list of changes you have noticed around you. Where are the animals that were about in summer and autumn? What animals do you see on page 65? Do you have ice and snow in winter where you live? Do you see evergreens in winter around you? Do you see animals' tracks in snow in the winter?

Help the children to recall that this is the same outdoors around Mary's school that was shown in the chapter "Autumn" on pages 12 and 13. Ask: "What season do you think it is now? Is it this cold in winter where we live? What is our winter like?" Help the children to note changes that have taken place where Mary lives.

Reading About Cold Winter Days. Guide the first reading of page 65 by using children's questions or comments or by asking such questions as: "What are Mary and the other children looking for? Where are they looking for animals?"

Encourage and help the children to discuss the last two questions on page 65. Could you have a similar firsthand experience outdoors with your children? Perhaps your children might reveal their interpretations of winter around them by painting a series of outdoor winter scenes. Write appropriate captions.

Some animals are about all winter.
These animals find food.
Hair and fur keep them warm.

Pages 66-67. Animals in the Winter

Discussing Winter Animals. Discuss animals around you in the winter. How do they survive? What food do they find? Where do they stay on cold snowy days? Do their colors change in winter?

Some children using Science Around You will be living in places where there is very little or no snow during the year. On the other hand, some children see snow almost all winter. All children can compare the woodland scene in the illustration on page 66 with that they see around them all the time. Wherever you are, you may help children to use the illustration on page 66 by asking: "How do you know it is a cold winter day? Do we have cold days like this?" Use children's comments and questions.

Discuss the snow and the protective white coats of fur of the snowshoe rabbit and weasel. Explain that these animals are looking for food. Discuss the fact that the hair and fur of these animals are new and thicker in winter; that the animals fluff out their hairs; and that this does not permit the cold air to penetrate so much. Explain that the color of some animals in cold places changes to white or a dull color and protects the animals from enemies. Do you see this change around you? Encourage children to give their reasons when offering explanations. There are several means of adaptation. Thus many animals are able to survive adverse conditions in winter.

Reading to Clarify Ideas. Well-stated questions should guide the reading. Rereading may be done to clarify opinions, to give additional facts, to resolve differences, or to answer questions. Think of reading as reading and discussion. Try not to feel too hurried.

Some animals hibernate on cold days.
They come out on warm sunny days.

Rejecting Guessing. Most children are acquainted with the squirrel and skunk in the illustrations on page 67. Do you see these animals around you all through the winter? On a very cold day, when children are warmly dressed for cold weather, could you take a walk to look for squirrels or other animals? Should you not see animals, help the children to think where they could be. Could they fly away? Could a squirrel run so far away to a warmer place? Did they all die? What do they eat in winter? Could you observe outdoors for some of these answers instead of just guessing? Encourage the children to reject guessing.

Stating Hypotheses. If the children are encouraged to think and to state hunches as hypotheses, you have an excellent opportunity to use still another

step of the scientific method with them. They need practice and guidance in stating hypotheses. Guidance can be offered through such questions as: "What animals stay about because they find food? Do some animals that we do not see for a few cold days sleep and wake up as people do?" Encourage children to check ideas.

Reading for Facts. You know that data can be gathered through observation and experimentation. However, when these methods do not answer problems or questions fully, you can help the children to see a genuine use of authentic reading material. Now you might ask your children to check their proposals or hypotheses by reading page 67. Guide the reading paragraph by paragraph, if necessary. Take time to let children discuss these ideas. The last paragraph applies the principle of hibernation to other animals that hibernate part of the winter. It also helps the children to reach a conclusion about partial hibernators.

Some animals are not around all winter.

Page 68. Some Animals Hibernate All Winter

Questions and Hypotheses. You may wish to use the same procedures as suggested for page 67. Could you take another walk to look for toads, frogs, and turtles? What does their absence suggest to you? Where are the animals that you saw last summer and autumn? Humorously, children sometimes question: "Could they fly away?" "Could they run away?" "Could they crawl to faraway warmer places?" "Can a frog swim to faraway places?" "Where do these animals go on cold windy days?"

Investigating Hibernation. Ask: "How do you know it is wintertime at this pond? What is the woodchuck doing? Where is his food? What is the frog doing? How has he changed? Are these animals above or below the cold frozen ground? How can you tell? What do the labels tell you? Why are these animals safe?"

Perhaps you still have a frog in the classroom for study purposes from the autumn or could get one to watch now. You might prepare a screened box or a terrarium much like the one on page 31 in Science Around You. Make it as much like an outdoor place as possible. Keep the terrarium in a cool place near the window.

After a very cold weekend your children may observe the absence of the frog. You might carefully uncover the soil from the frog and notice how inactive and somewhat shrunken he is becoming. At first he may seem dead and will not move when you touch him. Continue to observe your animal during cold days. What does your frog do on cold days? What does your frog do on warmer days? This is another means of adaptation.

Use the word hibernate to develop its meaning on pages 67 and 68. Other words, as rest and sleep, do not entirely express the full meaning of the word hibernate.

Seeking Reliable Information. You can develop a desirable attitude toward getting the best information possible by observing and investigating. A step in the process of getting accurate facts is to check with authentic reading materials. Now help your children to check their hypotheses, to get new facts, or to check their conclusions about some animals hibernating all winter by reading page 68.

Some birds migrate.
Some travel a long distance.
Animals do not think and plan as people do.

Page 69. Birds in Winter

Observing Birds in Winter. Encourage the children to tell about birds around them in winter. How do your birds look on cold winter days? Do their colors look duller than in spring? Do they look fat with their feathers fluffed?

Use the illustration to help children recall birds that stay with you all winter. Note the kind of habitat where birds are, such as bushes with seeds, wooded areas, and water. Why do birds look fat? How do their feathers look? Do you see sparrows or chickadees? What other birds do you see about you in winter that were not here last summer? Did they come from colder places? Will they return to those places in the spring? Now read for new facts.

Correcting Misconceptions. Throughout the study of animals and the adaptations to their environment, you must guard against the misconception or impression that they think and plan for the coming winter as people do.

Organizing Learning. You might wish to help children organize a bulletin board of their own pictures or others about animals in winter. They could prepare their own captions.

As your children listen to explanations, discuss firsthand experiences, or read to check facts, they will need help in organizing their learning. They may do this in the form of an experience reading chart. The following charts may be adapted and developed to suit your children.

OUR WINTER BIRDS	
Here All the Year	Here from the North
sparrows chickadees juncos	

OUR WINTER BIRDS

On January 4 we went to the park.
We saw some sparrows eating seeds.
We saw a chickadee.
He looked funny and fat.
His feathers were all fluffed out to keep him warm.
These birds stay around all year.

The roots of grass live through the winter.
There are four seasons in many places.

Pages 70-71. Some Plants Live Through the Winter

Observing Plants in Winter. Discuss changes you see made by plants. Do some plants above the ground look dead? Are the roots alive? What plants around you live through the winter?

Help your children to use these four spot illustrations in sequence to see changes in the seasons throughout the year. Help them to recall the spot from Mary's garden on page 4. What changes do you see? What plants have lived from autumn into winter? What plants died in the winter? Did all the grass die? What is the color of some of the grass in winter? Which part of the grass died? Which part of the grass may have lived through the winter? Could your children make a series of pictures to show plants through the seasons?

Reading and Predicting. Now you might guide the reading of page 70 to find out for sure about the grass that lived during the winter. Encourage the children to predict changes that will come in the spring. What will happen to the grass? While talking about one season, it is easy to talk about changes expected in other seasons. Use the illustrations to help you to anticipate and to prediot changes in the spring and summer. Then read page 71.

Help the children to summarize their ideas about some plants that live through the winter; that in some places there are four seasons; that they recur in regular order; that one season makes a unit of time; that several units of time or different seasons make a year.

Take time to discuss the questions addressed to the children at the bottom of page 71.

Trees live through the winter.

Pages 72-73. Trees Make Changes

Observing Changes. Do your children remember the changes made by trees from observing and reading about autumn? If you tagged a tree in the autumn to observe through different seasons, you might go out now to look at leaf buds. Are they small and hard?

Open a leaf bud to see if you can see tiny leaves which will grow out in the spring. Use a reading glass to enlarge the leaf buds if possible. Help children to see that they should remove only enough leaf buds for their study purposes. Take only a few leaf buds from one place. Plan to go to these same places during winter and spring. Discuss the fact that plants do not think and plan for coming winter as people do.

Some plants stay green all the time.
Some plants keep their leaves through the winter.

Do you have pine trees near your home or school? What trees keep their leaves and stay green all through the year? Could you look for a variety of evergreens around you?

Evergreens are not growing nor active during the winter. They do not lose their needles or leaves at any particular time. They lose only a few at a time. However, during the spring you will notice a new green growth at the ends of some branches.

In some places it is warm nearly all the year.
Plants grow and have flowers.

Page 74. Warm Winter Places

Using the Illustration and Reading. As the children look at the illustrations on pages 74 and 75, ask if they know what kind of a winter place this is? Do they live in a place like this? Have they visited a warm winter place like this? Introduce Sandy, who lives in this warm winter place. Do you know children who have never seen snow? Ask: "What kind of plants does Sandy have? Do you see plants like these around you?"

Some birds go a long distance.
They fly back and forth.

Page 75. Birds in Warm Winter Places

Using the Illustration and Reading. In the illustration note the vesper sparrow, kingfisher, goldfinch, and red-winged blackbird. If you live in a warm place like Sandy's, when do you see new birds about you? When are they not with you? Where do they come from? What other animals do you see around all through the year?

Using a Globe. Perhaps you might use a globe to locate a general idea as to where you live. Now show what is meant by a colder place or a warmer place. Some of these birds travel a long distance.

State departments of education, Audubon Societies, or other state and local agencies often have information about local plants and animals that is very helpful. You may wish to investigate this matter.

Pages 76-77. What Changes Do You See in Winter?

Using the Illustrations and Questions. These two pages are intended for review purposes. All the illustrations have concepts that have been developed in this selection. The questions on both pages will help the children to guide their discussions. In answering these questions the children should make use of their own firsthand experience as well as the information which they have read in Science Around You.

MATERIALS NEEDED

Material suggested for use in Science Around You:

reading glass

Materials suggested for use in this Manual:

frog or turtle	screened box
hot plate	square of glass (4" wide)
paints	terrarium
pan	thermometer
paper	tin lid

FURTHER EXPERIENCES

The more firsthand experiences children can have of seeing, hearing, feeling, tasting and smelling the better their concepts of science phenomena will be. Using printed symbols or words as in reading about these firsthand experiences is essential. Using word-symbols in their own writing is an important phase in the development of concepts, also. Language then becomes an important and inherent part in the development of concepts.

You may wish to use some of the following experiences to enrich your work with your children. These experiences should, of course, be used at appropriate places and as an inherent part of observation and experimentation.

Observing Animal Tracks. What animal tracks do you see in the snow around you? Can you help children to make their own hypotheses as to what the animals were doing? Do the tracks give a clue as to what the animal was doing?

Using Animals in the Classroom. Is it possible to keep turtles, salamanders, tadpoles, or a garter snake in the classroom for a while during the winter for closer study? Children should be encouraged to bring nothing into the classroom that they cannot care for adequately. They should try to provide those conditions in which the animal lived outdoors. These animals may not actually hibernate indoors, but the children will see that

they are less active than in spring and summer. Look at your animals after a cold weekend.

Experimenting with Water. See water in its different forms. Winter is a good time for children to have these experiences. They may bring snow indoors in a pan. The snow melts changing from solid snow to liquid water. They may keep the pan of water permitting evaporation to take place.

Then children may boil the water and learn that some of it goes into the air in the form of a gas (steam). Explain that it cannot be seen in this state; that it is very hot. Children should not try to touch steam.

If the teacher should hold a square of glass or tin lid near the white cloud above the steam, droplets of water will condense. Some of the remaining water might be placed outdoors. If it is very cold, the water will freeze. From such experiences help the children to state their conclusions as to these three forms of liquid, solid, and gas.

Recording Weather Changes. You may have previously planned and kept a weather record for a few days. In many places the changes in weather conditions during the winter are dramatic. Winter is a good time to keep another record for a short time. See "Air, Water, Weather" in Science Around You for suggestions.

Observing and Recording. Perhaps your children made a pictorial record of their observations during the summer and autumn seasons. Now you might paint another record to show cold winter days, how animals make changes in winter, how plants make changes in the winter, warm winter places, or any other changes around you. Writing short and simple stories about their observations of changes in winter should be within the abilities of your children now.

EVALUATION

During this work with your children did you see evidence that they have improved ideas of the adaptation of living things to conditions? Do they understand that in some places there are many changes during the winter and that there are few changes in others?

You might see considerable change in ideas and behavior in some children, while others may show only a little growth. However, a small amount of desirable change might be considered significant for some individual children within your group.

While using this chapter, did the children grasp the idea that plants and animals do not think and plan as people do? Are your children revealing a willingness to check their facts or differences of opinions by reading authentic material when they are not sure. Have they developed

greater responsibility in using and caring for living things in the out-of-doors?

You may wish to help the children collect pictures which reveal winter conditions in many places. As they give explanations, you may note growth made. They might organize a bulletin board with such captions as:

There are few changes in winter in some places.
There are many changes in winter in some places.
Some places have cold winters.
Some places have warm winters.

Does the vocabulary of your children reveal adequate use, for their level of maturity, of new science words, as hibernate, fur, frozen, alive, fluff, year, north, and evergreen.

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Hylander, Clarence J. Out of Doors in Winter. The Macmillan Company, 1943. Excerpt about living things during the changing seasons may be read aloud.
Zim, Herbert S. Frogs and Toads. William Morrow and Company, Inc., 1950. Excerpts about changes and adaptations of frogs and toads may be read to the children.

Films

Animals in Winter. (EBF) 1 reel, b/w. Shows how a variety of animals become adapted to changes in winter conditions. Some of the animals are caterpillars, owls, blue jays, badgers, and foxes.
Birds in Winter. (Cor) 1 reel, b/w and color. Shows the adaptation of birds such as a chickadee, a nuthatch, a junco, a cardinal, and others commonly seen in winter.
Winter on the Farm. (EBF) 1 reel, color. Reveals the seasons as they appear on a Wisconsin farm.

Filmstrips

In the Winter. (YAF) color.
Winter in the Country. (SVE) color.

VII · SOUNDS AROUND YOU

An infant's responses reveal the early growth and development of a child's reactions to sounds around him. He probably heard his mother's voice before he identified his own vocalizations. He was probably startled at times by his own sounds. He became a creator of sounds through his spontaneous babbling and endless banging of objects. This, along with his manipulation of objects, was the beginning of his interpretations of sounds in his own environment. With the passing of each birthday, he made significant progress in making interpretations and explanations of sounds around him.

Children live in a world of sounds, and the seven-year-old is ready for some further explanations or interpretations. He hears the sounds of rolling wheels, the whirl of motors, voices of people calling, singing, speaking, the roll of thunder, bells ringing, whistles blowing, or noises and sounds from many other objects. Some explanations or interpretations are needed to give greater meaning to some of his own actions, as well as to prevent or overcome fears which he may attach to certain sounds.

For the young child there are many firsthand experiences with sounds; with drums, spoons, clocks, bells, and other objects which make a good basis for understanding vibrations. From these firsthand experiences the child may generalize as to the direction of sound for safety purposes; that sounds not only affect our ears but that a sound does something to us so that we hear it. From these firsthand experiences with sounds the child may be enabled to attach greater meaning to what he learns from others and to the events of the physical world.

As he matures, he will understand better and appreciate the social significance of communication by telephone, radio, and television. As he matures, he will form attitudes and values which may give him a basis for action toward noise distractions in our towns and cities.

All these experiences and those in Science Around You will help children to become more adequate in making explanations. They will begin to get a feeling for the idea of energy although they may not use this word.

SCIENCE MEANINGS

The purpose is to give some interpretations of the following science meanings which will contribute to an understanding of the large pattern of energy, such as:

Sounds come to our ears through the air.
We hear sounds.

Some sounds are soft. Some are loud.
Sounds travel through the air and other materials.
You hear sounds when things move back and forth.
They vibrate.
Some sounds are noises and are unpleasant.
Some are pleasant.
Sometime our cities may be less noisy.
Some sounds are useful.
They tell us how near or how far away something is.

INFORMATION FOR THE TEACHER

Sounds, like heat and light, are forms of energy produced by substances. Sound waves can travel through a substance, but the sound itself is not a substance. Waves travel in water when a stone is dropped into it. Sounds travel through the air in the form of waves in much the same way. The waves are a manifestation of energy.

Sound is a form of energy. It is necessary to do work of some kind to produce sound. We do work when we blow a whistle, beat a drum, strike cymbals, speak, or sing.

You can feel a tingling sensation in your fingers when you lightly touch a piano or violin while it is being played. You can feel the vibrations of the stretched skin on a drum while it is being struck. You hear a high pitched note when you strike a table fork on a table and quickly hold it close to your ear. Something is vibrating wherever a sound is heard. That is, something is moving back and forth or up and down when it is vibrating. The molecules of air move back and forth or vibrate when a tuning fork, for example, is sounding.

WAYS OF WORKING WITH CHILDREN

Sounds come to our ears through the air.

Pages 78-79. You Hear Sounds

Experimenting with Sounds. You may wish to use this chapter when your children have some genuine concern, problem, or question to solve about sound. Or, you may wish to use this chapter to open up a new area of experiences. Have the children scan the pictures in the entire selection to get the general idea of the chapter. Listen to their comments. Returning to page 78 read the title and recall experiences with drums as shown in the illustration. Ask: "What are the children finding out about sound? What is moving when you hear the sound of the drum?" Encourage the children to name the sources of sounds coming to their ears through the air. What sounds do they hear? What is moving when they hear the sound?

Stating Hypotheses. Plan with the children to have on hand some of the materials shown in the illustrations.[1] Could they make a drum as the two boys are doing in the illustration? They might stretch an inner tube over a nail keg.

Encourage your children to make up their own explanations or hypotheses about sound. Ask: "How does the drum feel when you touch it? Does the drumhead jar or shake your finger when you feel it? Does the drumhead move when you strike it? How may we be sure that what you say is true?" Use the children's comments or questions as well as your own.

Reading Directions. The content of page 78 can easily be brought out in conversation before reading. Thus new words, such as beat, drum, finger, will be used in discussion before reading the printed word. Guide the reading of page 78 by asking a question, such as: "What are you to do as you beat the drum? What do you feel with your finger?"

Let the children beat and feel the skin of a drum moving. Note how lightly the girl in the picture feels the drumhead with one finger.

Should some children be unable to verbalize how the fingers felt, consider it an opportunity to reread and then try it again. Your children may use such words as shake, jar, tingle to describe the sensations. Since we are developing the concept of vibration, help them to use the word move, also.

Checking Hypotheses by Experimenting. Help the children to discuss how they may change the experiment to show that the drumhead is moving when they hear the sound. Fine materials, such as sand, may be used.

Guide the children in using the illustration on page 79 by asking: "What does the sand do when the child beats the drum? What do you think the children want to find out? How can you test your idea?" Encourage your children to check their hypotheses or ideas by doing the experiment.

Checking Experiment by Reading. This selection may be read before experimenting to see what to do. Guide the reading by saying, "Read to find out why the children are using sand." Or, use questions from the group. Or, page 79 may be read after experimenting. Then the children may check their experimentation with page 79.

Making Conclusions. It is unnecessary to use the word vibration at this point. Get the concept first of things moving and then we hear sounds. You might help your children to record their experiment and such conclusions as: The drum moves when we beat it. The sand moved up and down when we beat the drum. We hear the sounds. Sounds come to our ears through the air. Check your conclusions with those in the last paragraph on page 79.

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[1]Skin heads may be purchased from Peripole Products, 2917 Avenue R, Brooklyn, New York. Substitute materials, as heavy paper, skins, or cloth, may be used.

Some sounds are soft.
Some are loud.
Sounds travel through materials.

Pages 80-81. Sound Goes into the Air

Discovering Loud and Soft Sounds. As your children refer to the illustration on page 80, help them to discuss what they see, as: The boy is swinging the spoon; it strikes the table; the string and spoon swing back and forth many times. Ask: "What do you think the boy finds out? How can you be sure?"

Checking the Experiment. After the discussion of the picture ask the children to read to find if this experiment makes a soft or loud sound. To answer this problem they would have to try it unless you are merely willing to accept their verbalization.

Check the steps needed to perform the experiment by reading the first paragraph. Encourage discussion of sounds going through the air, in all directions, and coming to our ears, and the importance of good care of our ears. Check the children's opinions by reading the last paragraph on page 80.

Making Predictions. On page 81 discuss the changes in the experiment as shown in the picture. Encourage children to make proposals or predictions as to what will happen now. Encourage them to make up their own explanations. Say: "Read the sentences that tell you what to do. Will you hear a louder sound? How can you be sure?" Help children to try this experiment.

Reading to Check Hypotheses. Check their hypotheses by doing the experiment. Listen to their explanations. Ask, "How can you be sure?" Ask this question a second time after they have experimented. Note willingness to check their conclusion by reading the remainder of the selection on page 81. Compare their conclusions with those in the book. Thus you can help children to check their own thinking by experimentation and learn the importance of using authentic reading matter. This is another way to help children think objectively and to use an element of the scientific method.

Sounds travel through the air in all directions.
We can direct sound in one direction.
Sounds go through other materials.

Pages 82-83. Sound Goes Through the Air

Listening to Sounds. Here you have another opportunity for firsthand experience. Experiencing precedes the use of printed symbols and the generalization that when things move back and forth they vibrate. With a clock on hand have the children note and discuss how far the ticking sounds can be heard, that the ticking sounds come through the air, that the sounds go through the air all around them.

Reading About Sounds. You might wish to help the children check their thinking by having them read page 82. Help them to note the use of the stick in the illustration on page 83. Let them make proposals, such as: We can direct sound in one direction; sounds go through materials and we hear them better. Ask the children to check their conclusions by reading page 83.

Sounds come from moving things.
You hear sounds when they move back and forth.
They vibrate.

Pages 84-85. Some Things Vibrate

Discovering Vibrations. Take your clues from the illustration on page 84 to discover that some objects vibrate when you strike them. Notice how lightly the children touch the cymbal and triangle. Could your children use and tell of experiences with such instruments? Bring out in the discussion that things like the cymbals move (when you feel them) back and forth, that they vibrate. Use many other materials to discover what is vibrating.

New words, as vibrate, cymbals, and together, are sure to be used during the conversation.

Challenging Thinking. Some children tend to be verbal about the word vibration. However, you help them to think objectively when you challenge them to demonstrate or show what they say is true. Ask: "How do you know this to be true? How may we find out for sure?" You may guide the reading of the first paragraph on page 84 as an aid in experimenting or to check their own experimenting by reading afterwards.

Testing and Experimenting. Discuss the sounds of bells that you know at home or school. Notice the bell in the picture on page 85. Ask, "What makes this kind of bell ring?" Point out the dry cell. Examine one if possible. Explain that when a dry cell and bell are connected the bell will ring. These materials may be set up ready for the children to use since the vibration of the bell is the important point here. With guidance the children may use the illustration to set up the materials. Ring the bell. Ask, "How did the bell make your finger feel?"

Reading to Verify. Use the ideas developed in previous experiments showing how moving things feel when touched; that they move back and forth; that they vibrate. Read page 85 to verify your conclusions.

Some sounds are noises and are unpleasant to people.
Some sounds are pleasant.
Sometime our cities may be less noisy.

Pages 86-87. Sounds out of Doors

Discussing Outdoor Sounds. Discuss sounds you hear around you. What are the sources of the sounds? Note sources of the sounds in the pictures on

page 86 after reading the title with the children. Ask: "What sounds in the city do you know? What sounds would you like to hear less? What is vibrating?" Children may disagree as to which sounds are pleasant and which are unpleasant noises. Ask the children to read page 86 to find out about sounds in a city. Reread parts, especially the last two sentences. Listen to comments and note the children's attitudes toward and evaluation of noise in cities. What do they think about less noise in the world of tomorrow?

Use page 87 in a similar way. Note sources of the sounds of birds, water, bees, and leaves in the illustration. Whether or not you would attempt to distinguish between irregular and jumbled up sound waves of noise and the regularity of the waves of a musical tone would, of course, depend upon the maturity of the children.

Changing Attitudes. It is not unlikely that children may express some fears attached to certain sounds, such as thunder, machines, or animals. Attitudes toward thunder, for example, might be changed as children learn something of the causes and nature of lightning and thunder and some safety measures. New ideas may help to change attitudes as a result of new facts of science.

Some sounds are useful.

Page 88. Sounds Help Us

Stating Questions or Problems. Encourage children to discuss sounds that may help us. Do they mention sounds of warnings, time, work, play, or others? As you study each of the four illustrations, ask such questions as: "What do you see that makes sounds? Can you tell what is vibrating to make the sound? Do you hear sounds around you from things like these? How do you think the sounds help us?"

Avoiding Gullibility. In answer to the last question above do the children's comments seem reasonable? Read page 88 to compare their ideas with those of the authors. Do the children agree or disagree? Can they give examples of sounds warning that something is near or that something is far away? Discuss the last question.

Page 89. What Sounds Do You Hear?

Reviewing and Using Facts

1. What vibrating things can you feel? Children may feel the vibration of vocal cords by placing their hands lightly on their throats. Sounds are produced when air from the lungs is blown into the vocal cords in the throat. The vibration of the vocal cords cause the air column in the mouth, nose, and upper part of the throat to vibrate.

2. If you are in a new place, listen to see if you know sounds which come to you through the air. Children may recall the sounds they heard in a new place. This, of course, will be personal and vary among children. Note if the children can name the vibrating object.

3. Think of sounds you hear around you. Do the children distinguish between soft and loud sounds? Do they generalize, making use of experiments used on preceding pages, as: When things move back and forth they vibrate?

4. Take a walk outdoors. Make a list of sounds. This will vary but note whether the children can identify the vibrating objects.

MATERIALS NEEDED

Materials suggested for use in Science Around You:

bell	drums	sand	triangle
clock	dry cell	spoon	wire
cymbals	push button	string	yardstick or stick

Materials suggested for use in this Manual:

flag or cloth	tuning fork	whistle

FURTHER EXPERIENCES

These additional experiences may be used by the entire group or for small group work. They might be considered as a way to care for individual differences, also. An accelerated child or a child with special interest might go further with the study of sound and then report procedures and findings to the entire group. You might expect a wide range of interest in this work as in any other subject.

Learning About the Speed of Sound. Divide the children into two groups. Place them about 500 feet apart. Have one group use a good strong whistle. Let the second group use a flag or a piece of cloth. The first group blows a strong blast. The second group with the flag signals as soon as it hears the whistle. The group with the whistle observes that it takes some time for the sound of the whistle to reach the group with the flag. Repeat the experiment by interchanging the whistle and the flag.

Watching Vibrations. Sound is produced by the vibration of something. A tuning fork can show in a vivid way how the vibrating fork splashes the water. Strike a tuning fork lightly and touch a prong to water. Tuning forks may be purchased from a scientific supply house.

Explaining Echoes. Children frequently ask for an explanation of echoes. Have children listen to echoes while speaking in an empty auditorium, speaking

into an empty barrel, dropping rocks into water under a bridge and away from it, or perhaps speaking near a hillside. What explanations do children offer about echoes?

Notice the differences in sounds and the sound of the voice. Notice how sound is reflected so as to change the sound of their voices. Sound waves are reflected or turned back when they strike a solid object. In a vacant auditorium, the sound is reflected from the walls and other objects. These reflected sounds are called echoes.

Observing and Listening. Go to different places, as the playground, the woods, or a pasture. Be very quiet. Can the children notice the difference? Can they name the origins of sounds?

EVALUATION

It should be kept in mind that the spontaneous behavior of your children is useful in the evaluation of their progress in science. What kind of behavior did you see? Did the children show more interest in sounds around them? Do they make up their own explanations? Do they listen to the explanations of others? Do they consider hypotheses made by other children? Are they willing to test hypotheses? Are they willing to consider new ideas and to accept new responsibilities? Are they becoming more resourceful? Can they state important conclusions from their own experiences?

Did you see evidence that individual children grasped to some degree the large pattern of energy developed in this chapter, as: It takes energy and work to make sounds; that sounds move the air; that when things move back and forth they vibrate; and that some sounds are useful?

Organizing Ideas. Do you have evidence that children are making progress in using facts and ideas? They might make lists of facts from discussion, experiences, or reading. This helps children to make sound generalizations, too. The topic of a list calls for supporting details. You can help children to see the relationships between the title and the supporting details. You may wish to help your children organize what they have learned about sounds in the following way:

SOUNDS HELP US	
Near	Far Away
1. fire-alarm practice 2. 3. 4.	1. motor boat in distance 2. 3. 4.

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Geralton, James. The Story of Sound. Harcourt, Brace and Company, 1948. Selected excerpts of many kinds of sounds and vibrations may be read to the children.

VIII · SPRING

The out-of-doors can become a genuine place for learning through first-hand sensory experiences. Sensory experiences mean learning through seeing, hearing, tasting, smelling, and touching. From winter to spring children may see within a short span of time that many things change outdoors. Their own activities change in the spring. They can play outdoors later in the afternoon sunlight. They go to bed and get up in sunlight. Heavy winter coats, boots, and mittens are put away. Some of their games take on a seasonal aspect. Ice skates and sleds are put aside for kites and balls.

Children will enjoy exploring the events of spring with you. This is true whether you live in a city, on a farm, or in a suburb. Children who live in some regions may look for and see crocuses almost before the snow is gone. They see colors in the out-of-doors changing. Red and green fluff seems to change quickly to young leaves. Green becomes the color of spring. The children will tell of hearing the birds again at daybreak. They may see many young animals all around. They may be puzzled because some are hatched from eggs while others are born alive.

Experiences with children in their own environment seem almost unlimited. They can include the parks, woods, fields, meadows, ponds, brooks, their own school grounds, and yards at home. Children dig in the ground and find living and nonliving matter. They use tools and can prevent them from rusting. They listen to and identify outdoor sounds. They feel and smell the decayed leaves in a compost pile. Their morning and afternoon shadows are different from those of midwinter.

But children need teachers to help them build these rich concepts of their own environment. They need help in developing the skill to observe. Language is part of concept building. Children need help in the choice and use of words in expressing their interpretation.

Children need help to learn how to think objectively, to state questions or problems from their observations. They need encouragement in restating their guesses as hypotheses. They need to be challenged to check their facts or to offer reasons for what they say by observing, experimenting, or reading. They need guidance in stating conclusions. All these science experiences should be pleasant ones for children.

SCIENCE MEANINGS

You will note that three different regions are used in this chapter. Many children are curious and imaginative about places other than their own. This

may account for so much interest in space travel. Children who have never seen a desert may like to use the illustrations and to read about a desert. Thus the teacher should utilize well the parts of this book that deal with climates and regions different from that found in the child's own locality.

Part of the purpose of this book is to enlarge children's vision with ideas of adaptation, variety, conditions necessary to life, and interrelationships. The following science meanings will help you to develop these large science patterns:

There are many changes in the spring.
Days are longer and warmer.
Animals are active in the spring.
Young animals usually have as much care as they need.
Most animals live in places that are good for them.
Plants make many changes in the spring.
In some dry places water flows through ditches (irrigation).
A few plants may be picked from one place if there are many.
Plants should be left to grow outdoors.

INFORMATION FOR THE TEACHER

Living Things. Living things form a significant part of children's environment. They need help in developing a greater sense of responsibility for their environment. They will have a more intelligent sense of responsibility if they have some understanding of the patterns of adaptation and variety. There is a great variation among plants and animals and only a few have been selected for Science Around You.

You will want to use many of the plants and animals around you. They become adapted in many ways in order to survive. This chapter will deal with some of these ways. You may wish to help children to increase their power of interpretation by using many other kinds of living things around you.

New Plants from Seeds. Seeds that grow in the spring come from plants of last season. Annuals have this way of perpetuating their kind. Food is stored in the seed and insures the growth of a new seedling. There must be enough food within the seed for growth until the plant makes its own food. There is, of course, great variety in the size, shape, and color of seeds.

Some plants, such as perennials, have a large quantity of seeds, also. But these plants are not so dependent upon each year's crop of seeds. The parent plant can live on for several years and in the case of some trees hundreds of years. Children will begin to see how seeds are a means of adaptation of some species of plants.

Flower and Leaf Buds in the Spring. Trees and shrubs develop flower and leaf buds during their growing seasons. Their formation was started the previous spring or summer but remained dormant all winter. The leaf bud

is composed of a short stem enclosed by rudimentary leaves. Flower buds show rudimentary colored flower parts.

Since their buds formed the rudimentary structure nearly a year in advance, plants can resume growth activities as soon as conditions are favorable. Changing weather conditions can do great harm to the buds at times. These leaf and flower buds are ways of adaptation.

Animals in the Spring. Seasonal changes affect animals in many ways. The amount of sunlight, as well as the availability of food and the temperature, influences the activities of animals.

You can help children to gain ideas how animals manage to survive. They can see how animal homes have been useful in their survival. Some birds, for example, build their nests high in trees, others on lower branches, or even on the ground. Some animals get protection in the home as well as use of it while raising their young. These are only some of the many ways of adaptation of animals. Children do not need to use the word adaptation. You will recognize if they seem to be moving in the direction of this larger pattern of thinking.

Young Animals. The length of time of parental care among animals varies, because animals are born at varying stages of development and because the length of time required to reach maturity varies. As soon as most animals can get food and protect themselves, they are on their own.

Some animals have their young in their underground homes where they have lived all winter. Ground squirrels dig burrows in open fields. There they raise their young. Skunks may raise their young in a den or hollow log where they hibernated on cold winter days.

The gray squirrel frequently lives in the trunk of an old tree in the winter. Here the young are usually born in the early spring. In the summer a second nest is sometimes built in the fork of two branches. It is made of leaves, bark, and sticks, and lined with grass.

Birds Build Nests for Their Young. Birds have many enemies, such as cats, squirrels, skunks, snakes, other birds, and other animals. Birds usually construct their nests as inconspicuously as possible. Materials similar to those of the background are used. Nests are usually found near the place where there is food.

The Baltimore oriole builds a nest so that it hangs from the end of branches. The nest is constructed of plant fibers, hair, and string. A red-headed woodpecker pecks out a gourd-shaped hole and pads it with the chips. A whippoorwill constructs no nest but uses a slight depression in leaves. It is found on the ground of woods, protected by other plants. The mallard duck builds a nest of reeds and grasses lined with down. It is on the ground among high grass or reeds. It is usually near water. A ruby-throated hummingbird

constructs a nest of plant-down with tiny pieces of lichen outside. A white-breasted nuthatch makes its nest in a deserted woodpecker hole high enough above the ground for safety.

Many birds have ways of protecting their nests and young. Nests are usually found in places where a certain kind of bird can get food for its young.

Of course, the nests of birds should never be disturbed. An abandoned old nest might be taken for certain study purposes. One should make very sure that a nest is abandoned before removing it.

WAYS OF WORKING WITH CHILDREN

There are many changes in the spring.
Days grow longer and warmer.

Pages 90-91. Spring Is Here

Observing Children. You will surely want to begin with the experiences your children are having in the outdoors around them. Do they sometimes feel irritated by heavy winter clothing and wish for warm spring weather? Do they ask when spring will come? What comments do they make about changes around them in the spring?

If you have followed some of the suggestions in the chapters about "Summer," "Autumn," and "Winter," you have watched changes through the seasons, the change to autumn colors, falling leaves, leaf buds, and the visible absence of such animals as toads, turtles, certain birds, chipmunks, woodchucks, or other common animals around you. Now the school grounds, parks, woods, ponds, meadows, or fields can become your outdoor place for firsthand experiences again. If this is not possible, you might use your classroom windows more to see changes in living things. Keep the larger pattern of variety in mind as you observe with the children.

Seeing Changes in the Spring. You might wish to help the children to compare changes in the autumn on pages 12 and 13 with those on pages 90 and 91. Make similar comparisons of changes you see around you. Ask: "What season do you think it is now where Mary lives? What makes you think so? What changes do you see?" Use the children's questions or comments. Read page 90 to check their thinking.

Help the children to see the changes on pages 90 and 91, such as: It must be warmer; children are wearing light wraps; the crocuses are out; the robin must be building a nest; it has a string in its mouth; and there are ducklings with the mallard ducks now. Help the children to bring out that there is more sunlight, that days are longer, and that it is getting warmer.

Reading to Check Interpretations. Now ask your children to check the changes they discussed with page 91. Ask, "Why are the children outdoors?"

These two pages should be an enjoyable experience and start a series of first-hand experiences. What changes do you see around you? Are plants changing? Do they look the same as last week? Are animals changing? Are the days longer? Is it getting warm?

Listing Changes You See. Deepen the concept of change with your children by listing some of the everyday changes they see, hear, smell, and touch. You might keep a record for a week. Watch for the unusual as well as the commonplace. Here is the list as reported by a second-grade group in the early spring:

Some trees have red and yellow fluff like leaves.
The leaves turn green in a short time.
We play outdoors longer.
The grass grows fast now.
Leaf buds are larger. Some have opened.
Mr. Brown plowed our garden today.
Kites fly. Birds sing. Violets grow.

Animals are active in the spring.
Birds are moving about.
Some birds return in the spring.

Pages 92-93. Birds Are Moving About

Watching Birds Around You. Do you have a thicket or woods that you can call your own bird park? Can you go there often to look for birds? Can you go at different seasons of the year? Or, use the children's experiences while going to and from school.

Help the children to recall the absence of birds around them during the winter. Ask, "What do you think the birds are doing now that spring is coming here?" Help the children to see in the illustration the flock of geese flying in formation high in the sky. Where are they flying (north)? Why might they stop? Some of the birds may rest or eat before flying north.

On page 92 you see birds that may have been in Sandy's warm winter place. From left to right they are a vesper sparrow, cedar waxwing, and goldfinch. It is not important that children identify these particular birds. Encourage the children to describe the birds they see and where they saw them.

Checking Opinions. Known birds which the children may see will vary. You should expect differences of opinion among your children. Check their opinions by reading page 92. Ask: "Will the birds stay here? Will they fly north? Why do they stop?" Make a list of birds that will stay around you all summer; birds you did not see in the winter.

Birds are noisy in the spring.

On page 93 you may wish to ask: "What do you think the birds are doing? Are they like the birds of last autumn?" This recall will reveal to you the ideas children have remembered. You may wish to refer to the illustrations

and read pages 20 and 21 again. What are birds around you doing now? Check your opinions with the facts on page 93.

Helping Birds. You might plan with your children to put out a tray of materials somewhat like the one on page 93. You might collect bits of down, thread, paper, cloth, a container of mud, leaves, and twigs. Put the tray of materials in a somewhat secluded place. The children may observe some birds using the materials. Record your findings.

The birds in this illustration are a robin on the ground, a bluebird flying, a Baltimore oriole and a catbird on the tray. Children might learn the names of only those birds they can see around them.

Many birds build nests to raise their young.
There is variety in nest construction.

Pages 94-95. Young Birds in the Spring

Seeing Many Kinds of Nests. These two pages show a variety of birds in their habitats, their ways of nesting, variety in color and size and in some cases in the number of eggs. Look at the first picture on page 94. Have any of your children seen a Baltimore oriole's nest close up? Have they seen its construction of plant fibers, hair, and strings? Ask, "Why is this a good nest for eggs?" Read the first paragraph to be sure.

Use the second illustration by asking: "Have you seen a bird like this one? What kind of a sound does he make? What kind of a nest does he build? Is this a good nest for eggs?" Check your ideas about the woodpecker with those of the second paragraph.

Examine the whippoorwill's nest at the bottom of page 94. Use your children's comments or questions or ask: "Where does this bird make its nest? Why is this a safe place?" Now read the last paragraph.

Use the illustration at the top of page 95. Ask, "Why does the mallard duck build its nest near water?" Read the next two paragraphs.

Use the hummingbird's nest. Discuss the size, shape, construction, and eggs. Study the white-breasted nuthatch's nest and the bird feeding its young. Read and discuss further the last two paragraphs.

Could you take a walk to look for these or other birds and their young around you? Help the children to see that what is good for one animal may not be good for another.

Observing Children's Behavior. On your walks in a park, the school grounds, or a wooded area, will a child stop suddenly to listen to a particular bird? Is he becoming sensitive to the sounds of these birds? Is he interested in a nest and eggs but careful to leave them alone? Does he tell about the birds he sees around his home? Does he assume more responsibility in protecting them? How does he try to protect birds?

The purpose of the authors here is to develop an increasing sensitivity and appreciation of birds and of their adaptation through the seasons. It is not necessary to collect a mass of facts and to identify birds in pictures; but it is important that boys and girls help to protect them.

Some animals have more than one home.

Pages 96-97. Other Animals in the Spring

Seeing Different Habitats. Help the children to see in the illustration some common animals that are about in the spring. Do you have animals in the spring that are different from those on pages 96-97? In what kind of habitats or places are the animals found? Do some live in or near water or marshy places? Do some live in deep shady woods? Do some live in fields, meadows, or open woods?

On page 96 note the nest above the water made by the muskrat. Explain that it is built of mud, roots, and stems in shallow water; that there is a room inside that is above the water line; that the muskrats store food inside the room; that the entrance is under this dome-shaped house; that the young are born in burrows along streams; and that the muskrat will fight other animals to protect its young.

Each young animal has as much care as it needs.

Discussing the Care of Young Animals. Help your children to see these young animals or others in their natural habitats; the young skunks were probably born in the old log where the skunk hibernated on cold days; and the woods protect the deer and their young.

You may wish to refer to page 67 and recall where the skunk hibernated on very cold days but came out on warm sunny days. Bring out in discussion that the length of time these animals care for their young depends upon their stage of development at birth and how long they take to mature. You will note the spider in its web takes no care of its young. They do not seem to need it.

Looking for Young Animals. Encourage the children to tell about the care of any young animals they know. Could you plan a walk with your children to see what animals are around now? What young animals do you see? How are they cared for? Daily walks or very frequent walks are good experiences for children. Your discussions and observations outdoors should focus on the changes animals are making in the spring; that children should not disturb the animals. Read about the care of young animals on page 97. How do your children react to these ideas?

There are many changes in the spring.
School grounds should be safe and clean.

Pages 98-99. Changes Around the School

Observing Changes Around School. On page 98 help the children to see many changes that go on around a school in the spring. If appropriate, compare changes in the illustration with those around your school or those on pages 64 and 65 in Science Around You. Do they see that the children are planting a seedling and filling a gully? What explanations do your children offer regarding work around the seedling and gully? How will filling the gully and planting seedlings help the school grounds?

Reading for Facts. Discuss whether or not you think these children like their school. Ask these or similar questions: "How may we care for our school grounds? How may we make our grounds safe? How may we make them look better? What changes do you see on your grounds?" Check your questions with those on page 99. What can you do about these problems or others on your school grounds?

Plants keep soil from washing away.
Weeds can be useful sometimes.

Preventing Soil from Washing Away. Help your children to see that the soil is not washing away on page 99; that it is untampered with by people; and that it is a natural place of plant growth. Notice how naturally grasses and weeds grow at the left; that the next grasses and weeds are a little taller; that next there are seedlings growing (growing from seeds blown there by the wind); and that next there are full-grown trees.

Explain that the grasses and weeds grow first and are followed by a succession of larger plants; and that all these plants help to hold the soil. Could you try to see such a succession of plants around you?

Could you try to keep a place of natural growth near you for study purposes all through the year? Which plants come first? Then do you see larger plants?

Most animals live in places that are good for them.

Pages 100-101. Where Should Animals Live?

Taking Care of Animals. You may wish to have the children look at the three illustrations in sequence. Notice that the turtle is in its natural outdoor habitat, crawling in warm sunny sand toward water; the terrarium containing the turtle; then the turtle outdoors again. Ask: "What did the children do with the turtle? What would you do if you found a turtle outdoors?" Suggest that they read page 100 to find what Mary and Bob did with their turtle. Did they care for the animal well?

Ask your children if they agree with Bob's proposal to make a place for the turtle in a jar? Encourage your children to be critical of the place provided by Mary and Bob. Is it large enough? Is it too small? Can the animal move around? Is the jar like the place the turtle lived in outdoors? Where does the animal live outdoors? What would your children do? After discussion, with an attempt to clarify the reasons for letting an animal remain outdoors, do your children agree with the last paragraph on page 100? Can they put these ideas into practice?

Should a frog, toad, turtle, garter snake or some other animal be brought to school, perhaps you could test the action of the children. Make a place for the animal to live where it will have as good conditions as possible. Do they intend to keep it for a day or two and then return it to its wooded environment? This is a good practice for all animals brought to school.

Plants change in the spring.
Leaf and flower buds open in the spring.

Pages 102-103. Changes in the Spring

Watching Changes in a City Park. Call attention to the fact that this illustration shows Betty's city; that it is spring in a city park. Ask, "What changes from winter to spring do you think that Betty can see?" Read the first paragraph on page 102 to check your comments.

Use the last paragraph to guide a trip outdoors. Use a reading glass to look at flower and leaf buds if possible. Many children using Science Around You will be living in cities where the parks will offer great opportunities. Everywhere children will see that plants make changes in the spring.

Examining Buds. Have the children examined leaf buds several times during the autumn and winter? You might help them to select a few specific branches with buds to watch. They can see when the tiny leaves begin to develop. They may discover that some of their buds are flower buds.

A few twigs with buds might be brought indoors to open and examine more closely under the reading glass. Only a very few twigs should be taken and not many from the same place.

On page 103 you will notice the green grass; that roots lived through the winter. Can you examine some roots where grass is still brown. Leave the ground and grass in good condition so that soil will not wash or blow away. Examine the spot later to see if the roots were alive and grew.

Examining Bulbs. Help the children to open a bulb as suggested in the last question. Make a list of what they see on page 103 inside and outside the bulb. Use your reading glass to see the new plant inside the bulb. Check their comments by reading page 103.

Use the cross section of the bulb to associate such words as bulb, roots, and new plant with the parts. Could you make charts with labels after you open and examine the parts of a bulb.

Living things change in the spring.
People in the city want birds.

Pages 104-105. Spring in the City Park

Using a Park Wisely. It is the responsibility of the school to help acquaint children with some of the facilities that a city offers. Perhaps the group might select a part of a park to watch and call it their very own. They might become observant enough to note changes that occur there, as: budding of trees, leaves developing from buds, the grass becoming green, birds that were in the park during the winter, their sources of food and protection, migrant birds stopping to rest and eat, nesting of birds, laying of eggs, raising of young, and the growth of flowers.

Note the behavior of your children. Do they use the out-of-doors wisely? Do they have pride in their city park?

On page 104 you see a chipmunk with her young. Do your children see chipmunks around them? Did they miss them while they were hibernating in the ground on cold winter days?

On page 105 you see sparrows and pigeons. They were in the park during the winter, too. From left to right you see the migrating goldfinch and flicker. Read pages 104 and 105 to find out more about birds in a city park.

Developing Attitudes. Children should be helped to feel responsible for the environment and to take pride in the natural beauty of their region. Children are young citizens who can be helped to care for a park, its plants, birds, and other animals; to know that people want these living things in their city parks. Do your children refrain now from picking flowers, pulling leaves, or breaking limbs of a tree outdoors? How do your children react to the second paragraph on page 105?

In some dry places water flows through ditches.
The water comes from far away.

Pages 106-107. Spring Comes to a Dry Place

Getting Water to Dry Places. Help the children to recall that this is Tom's place; that he lives where it is hot and dry. Ask: "What time of the year is it on Tom's farm now? How do you know that it is spring?" Compare and discuss changes you see here with those on pages 8-11. Help the children to see that Tom and his father are working in the garden; that they are letting water into some of the ditches; that the garden is green and growing where there is water in the ditches; and that the water comes from far away. Read page 106 to check your comments.

Do you live on or near an irrigated farm? What firsthand experiences can your children tell about? Can your children show their interpretations by making large pictures?

There is some rain in dry places in the spring.
There are many flowers for a short time.

Some children using Science Around You may live near a desert and see the cactus plants in bloom like the ones on page 107. Other children may have traveled over a desert after the spring rains. Children may be able to bring pictures of desert flowers. Ask: "How do the plants get water to grow? How does Tom's garden get water?" Read page 107 to check your ideas.

Bring out in your discussion such facts as: After a rain the soil may be covered with flowers; the seeds are in the sand during the winter; in the spring the sun and rain make the seeds grow; the plants bloom and have seeds; they lie in the sand until the next spring rains come.

Pages 108-109. Spring in Many Places

Reviewing and Summarizing. The purpose of these two pages is to help children think and recall the three widely different regions developed in Science Around You. Encourage your children to look at the illustrations of Mary's, Tom's and Sandy's places on these two pages. What can they tell about these three places? Ask, "Which place is most nearly like yours?"

Do the children know that some places are different from their own place? Do your children live in a place of few changes? Do your children live in a place of many changes? Do they know that in some places the land is irrigated? Do your children show interest in places other than their own? Do you think their concept of space is expanding?

When there are many plants in a place a few may be taken.
When plants are taken they should be cared for.

Changing Behavior. In the first illustration on page 108 Mary is looking at the flowers. Ask: "What do you think Mary is thinking about? Why do you think Mary should not pick these flowers?" The responses may vary.

Bring out in discussion: There are only a few of these flowers; there will be seeds; they make new plants; and that people should not pick flowers when there are only a few. Now read the first paragraph on page 108 to see what Mary actually did. Do your children agree or disagree with Mary? What experiences can children tell about which reflect other attitudes?

The second illustration and paragraph show that when flowers are plentiful a few may be picked. Do your children put these ideas about wise conservation into practice? Children need many firsthand experiences, planning, and evaluation to change their behavior patterns. Have

you had an opportunity to observe the behavior of your children along these lines?

MATERIALS NEEDED

Materials suggested for use in Science Around You:

animal (small turtle or frog)
bulbs (tulip or onion)
seedling (tree)
terrarium

Materials suggested for use in this Manual:

baking dish (glass)
bulbs (onion or tulip)
gardening tools
materials for nest building (string, down, paper, cloth, leaves, twigs)
paints (cold-water)
paper (large piece 4' × 15')
plants (lettuce, radishes, onion sets)
reading glasses
seeds (beans, pumpkins, radish, lettuce, popcorn)

FURTHER EXPERIENCES

Children in your group may vary widely in individual interests and abilities. You may wish to use some of these experiences to care more adequately for individual differences among your children.

Recording Experiences. Make a calendar or keep a diary of events.

BIRDS WE SEE AROUND US	
Date of Arrival	Where We See Birds
May 1 Baltimore oriole May 3 mallard duck	top of elm tree near the pond

CHANGES WE SEE IN THE SPRING	
March 15	crocuses in schoolyard
March 26	leaf buds opening on willow tree
March 27	robin getting strings from tray
April 1	earthworm in our garden

Making a Garden and Watching Changes. Discussion and planning should take place before the actual gardening begins. There can be indoor experimentation with seeds, the propagation of plants, collecting and learning how

to use tools and how to care for tools to prevent rusting, and locating a garden spot with an adequate amount of sunlight and drainage.

Some plants might be planted which can be harvested and used before school is out, such as lettuce, radishes, and onion sets. Some seeds might be harvested in autumn, such as popcorn and pumpkins. These products could be used by children in the autumn. The next experiments might be used with the gardening.

Digging in the Ground. Encourage children to see the variety of things within the soil, as earthworms, larvae of insects, hard and soft rocks, roots of plants, tiny living plants, and decayed leaves or stems. Use reading glasses to examine the contents of the soil more closely. Children may tend to remove earthworms. Help your children to see that the earthworms are helpful. They help to keep soil soft so that air enters the soil more easily.

After digging, the children should smooth the ground. They should see that the soil does not blow nor wash away. The place used for digging should be left as good or even better as a result of the children's study.

Watching Seeds Sprout. Experiment with large seeds, as bean, pumpkin, or Lima-bean seeds. Use a glass baking dish. Place crushed wet paper in it. Place the seeds so that they can be seen. Keep it moist. Watch the stem and leaves grow up. The roots grow down. Open a seed to see the young plant inside. Seeds have food stored within them for the early growth of a plant.

Examining Bulbs. Examine the outer and inner layers of a bulb. You might open one onion and examine its inner part. Place another onion at the top of a tall glass filled with water. Watch the roots and stem develop. Record your observations.

Watching Insects That Make Changes. If the children find a cocoon that still contains the pupa, they might bring it into the classroom in order to see the moth emerge. A cocoon may be brought indoors in the spring if it is warm for study. The moth may be released into the out-of-doors when it comes out. The children should understand the reason for bringing the cocoon in now rather than in autumn or winter. The cocoon should be carefully suspended so that the moth can spread its wings. Record your observation.

EVALUATION

The four chapters on the seasons have called for many trips outdoors. Have your children gradually made progress in how to move as a group while on an instructional trip outdoors? Children usually need help in distinguishing between free playtime outdoors and a trip which has a study purpose. Do

you see less tendency to pull plants? Are your children inclined to leave things outdoors where they belong?

Here is another way in which to evaluate the progress of children. Making a large picture or mural calls for planning, selecting, and organizing ideas, as well as for the expression of these facts and ideas. Several themes might be selected for different pictures, as: Plants we see around us in the spring; animals around us make changes in the spring; there are many young animals; some animals have much care; and people make changes in the spring. Discussion and planning will necessitate recalling details and grouping facts or conditions. Thus children use what they have learned with a new purpose. In such an activity, science meanings, attitudes, and language power are revealed to you. You will want to size up each individual's contribution and his progress.

Have you seen other evidences of changes in behavior? Are your children curious about places other than their own locality? Has this contributed to their concept of space? Do they see to some degree that plants and animals are adapted to living under different conditions?

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Spring on the Farm. (YAF) 1 reel, color. Shows many activities of the farmer, as plowing, harrowing, fertilizing, and planting, as well as plants and animals in the spring.

Spring on the Farm. (EBF) 1 reel, color. Shows the adaptation of plants and animals to the changing seasons.

Filmstrips

In the Spring. (YAF) color.

Plants and Animals in the Spring. (SVE) color.

IX · FRICTION

Long before the seven-year-old entered school, he had experiences with friction. There has been learning through sheer manipulation since babyhood. He touched skin and it seemed smooth or rough. He may have crawled over a floor or rug. There he may have explored the difference between a rough rug and the edge of a waxed floor. He would pat first one and then the other. He responded to smoothness or roughness. He became sensitive to the smoothness of ice, a tin pan, or cotton clothes. He responded to rough and scratchy surfaces.

As the seven-year-old learned to explore space around him, he played outdoors. He became sensitive to thick soft grass or a sandy rocky spot. In some places the ground felt rough, sometimes smooth. Some rocks were smooth; others felt rough. Often he slipped and fell. He may have felt unhappy because his skin was scratched when he fell. He soon learned that falling on certain smooth places did not rub as hard as the rough places. There was much learning through touching and responding. Long before he was verbal about rough and smooth objects, he had learned his reactions to rough or smooth objects.

Soon the young child manipulated all kinds of toys. Some he pushed or pulled over rough places. Others he pushed or pulled over smooth places. At first he may have played with a sliding train or car. Then he pulled a wooden train with wheels by a string. He learned that smoothness or roughness of the surfaces made the sliding, pushing, pulling, or rolling either easier or harder to do. Each birthday may have found him using or overcoming resistance of friction with new toys or other objects.

At six and seven he made great strides in using or overcoming friction. He played with a train on smooth tracks. He learned to use skates, sleds, and sometimes a bicycle. He liked to slide on smooth surfaces but he learned the advantages of wheels, also.

Then the growing child became sensitive to the fact that rubbing surfaces made for wear. He saw holes in shoes and often at the elbows and knees of clothing. He may have noticed the rough or smooth tread on the tires of cars and trucks. He may have noticed the worn places on steps as he went up or down.

However, children using this selection in Science Around You will need help to understand the meaning of and to become verbal about friction in their everyday experiences. Much of their learning has been through touching and feeling and other sensory experiences. You can help them to use words to interpret these experimental learnings about friction.

You will want your children to be able to do more than describe their experiences with friction. With your help they can make interpretations. With your help they can give their own explanations. They can relate cause to effect. They can interpret some of the conditions that make their experiences what they are. Watch for growth along these lines.

SCIENCE MEANINGS

Help your children to plan their science experiments with you. Watch for evidence of their growth along the lines of co-operative planning. As you plan and work in this area of friction, the following science meanings will contribute to an understanding of the large science pattern of energy:

Some things are rough. Some things are smooth.
Rough things rub more than smooth things.
Rough things make more friction than smooth things.
Rubbing makes things warm.
There is friction when things slide together.
Sliding things rub hard.
Brakes make things stop.

INFORMATION FOR THE TEACHER

People take friction into account in many everyday experiences. They walk more carefully on a wet pavement than on a dry one. Many things that people do are modified in some way by friction.

Energy. Objects in motion tend to keep on moving. Objects at rest tend to remain motionless. Some source of energy is needed to start and stop objects on our earth. Energy must be exerted to overcome friction if objects are to keep moving. Moving objects lose their energy when they are stopped.

This energy of moving objects must be transferred to some other object. In brakes this energy is turned into friction. Brakes on trains or cars serve this purpose. Children use brakes on wagons and scooters. The brake may be a stick pressed against the wheel or they may drag their feet on the ground.

Smooth and Rough Surfaces. We all know that it is more difficult to rub two rough surfaces together. There is a resistance between the two rough surfaces. Friction is the resistance encountered when one surface rubs another surface. In fact, when the surfaces of two objects rub together, they may become slightly warm or very hot. The heat represents the energy used to overcome the friction.

It takes energy, for example, to pull a nail out of a piece of wood. The nail will feel warm when pulled out. The warmth represents the energy used to overcome the resistance or friction in pulling the nail out of the wood.

A sled will not slide long unless we use energy to push or pull it. It stops because there is friction between its runners and the ice. There is less friction on smooth ice. If you rub two smooth surfaces together, there is little friction. The rougher the two surfaces are, the greater the friction.

Gravity is also a factor in considering the amount of friction between two surfaces. When we pull an empty box across the floor, there is friction. If we load the box heavily, it is much harder to pull across the floor. Gravity is operating on the box just as it is on everything on the earth.

Some surfaces look very smooth to the eye. Surfaces of the skin, certain metals and cloth, different kinds of wood or floors look smooth to the unaided eye but may look rough under a microscope or reading glass. Our feet push against the floor by means of friction. Otherwise, our feet would go backwards and we should not be able to go forward.

There is less friction on waxed floors than on one that is unwaxed. Examine the surface of an unwaxed floor with a magnifying glass. You will no doubt see that there are many rough spots which rub against our shoes when we walk or slide. You would be unable to slide far without stopping. On a smoothly waxed floor the places between the rough spots are filled with wax. Therefore, you slide more on a smoothly waxed floor.

Sliding and Rolling Friction. You observe two kinds of friction. They are sliding and rolling friction. When you push a chair over the floor, you overcome sliding friction. The rolling friction of the baby carriage is less than sliding friction. The wheels change the sliding friction to rolling friction.

The wheel was one of man's great discoveries for decreasing the friction he worked against. There is some friction between the wheel and axle but there is less than between a wagon without wheels and a road. Friction is further reduced by lubrication with oil.

Two surfaces are rubbed together in sliding friction. Rough surfaces create more friction than smooth ones. The rough places in one surface catch against the rough places in the other. This causes friction. The bumps or rough places on a wheel roll over the rough places on a road. They do not rub against each other as much. This is rolling friction. It should be noted that even smooth surfaces have some friction.

WAYS OF WORKING WITH CHILDREN

Some things are rough.
Some are smooth.

Page 110. Smooth and Rough Things

Examining Surfaces. Could the children examine and tell about rough places on toys or other objects that have been rubbed smooth? Try to get

the ideas of your children about rubbing smooth and rough objects. While their ideas may not always be correct, they should be encouraged to express what they know and think in an orderly way.

Introduce the title of this chapter, "Friction," after some firsthand experiences and discussion about friction when two things rub together.

Ask, "What do you think the children will discover about rubbing these objects?" Can you examine similar objects (glass dish, sandpaper, tin plate, woolen cap, wood) as well as others? Children are using their own energy in rubbing surfaces.

You might wish to examine the smoothness and roughness of your objects under a reading glass. Do you see little holes, spaces, or rough spots on surfaces?

Examine some sandpaper. Are there differences of opinions about smoothness and roughness? If so, ask, "How can you be sure about what you say?" Suggest, "Read the first paragraph on page 110." In answer to the two questions you might group your objects. How do your children state their conclusions? Read to check with the conclusion on page 110.

Organizing Learning. Here is a simple way to help children organize facts and conclusions. Some children need opportunities for easy organization.

SMOOTH AND ROUGH THINGS	
Smooth Things	Rough Things
skin silk glass ice	wood wool pavement sandpaper

Rough things rub more than smooth things.
Rubbing makes things warm.

Pages 111-112. Rubbing Warms Things

Checking Predictions. It will probably be worth your time to do a little sawing at this point, or use this material as you need to in other work experiences. Ask the children for their explanations: "What rubs here? Is it harder to rub some things together?" Or, use questions and comments from discussions.

Discuss rubbing as in sawing wood or sandpapering. Compare with some things that rub easily. Ask, "What do you think will happen when the rough wood and rough saw (teeth) are rubbed together? (Predicting.) Encourage your children to tell about their own experiences with sawing wood. Do they mention the fact that the saw gets warm as it goes back and forth? It is very likely that they will not. Then ask, "What happens to the saw when it rubs the wood?"

Now read page 111 to see if the points you have discussed agree with this selection. Encourage the children to show that rubbing makes heat.

Help the children to interpret the situation in the first illustration on page 112. They will no doubt say that it is a cold winter day; that Bob and Mary are dressed for cold weather. But interpretation is more than just describing.

You may need to guide their thinking a little more by asking, "What are they doing to keep warm?" Now read the first paragraph to find out for sure. Now can your children give other examples of rubbing producing heat?

Encourage your children to express their ideas about this question by asking: "With what does Bob seem to be rubbing the table? What will happen to his fingers or the table?" Read the first paragraph to check their comments. This experience also suggests the value of using many everyday experiences around children. You can easily test this simple experiment by trying it.

Read the last two sentences. Could your children do this? Do children who are verbal about this situation show a willingness to check their conclusions by using these materials?

There is friction when things slide together.
Sliding things rub harder than rolling objects.

Pages 113-114. Moving a Heavy Box

Planning with Children. Use this situation if possible when you need to move a heavy object, such as a box of blocks, rocks on the school ground or a box of books, or in some other problematic situation. Identify the problems, such as: how to get the load lifted, how to move as one load rather than piece by piece to save time, and how to make the work easier. Encourage questions or hypotheses, such as: "How may we move the box of lumber easily across the room where we want to work? What holds the box? The box is hard to move because something is holding it."

What problem do the children have? How do you think the children feel? Why are they having trouble? How would you move the box? Suggest, "Read the explanation on page 113 to find out what is holding the box."

After reading take time to let the children give their explanations about friction. Add to the children's interpretation, if necessary, such factors as the weight of objects, the roughness of surfaces being rubbed, the amount of energy they use, the pull of gravity, there is much friction in sliding objects, and work is done when the object is moved.

Stating Hypotheses. Do the children suggest hypotheses? Ask, "How do you think we may overcome this friction?" Listen to the hypotheses of your children. Encourage them to make their own explanations. Some may be wrong, but you can try them out and show that their hypotheses do not work.

Some hypotheses might be: "Move the box by pushing and pulling harder. Have more children push and pull. Move the box by lightening the load a little."

It will not be necessary to tell the children that their hypotheses are incorrect if they can discover this by trying them out.

Use page 114 to help the children get the ideas for overcoming friction. Note that Bill is using a lever to raise the edge of the box; that the rock acts as a pivot point for the lever; that others have broomsticks; that the children are doing work when the box moves; and that it takes energy to do this work.

Ask: "Do you think the rollers will help to move the box? How do rollers help? Is there more or less friction now?" Read the paragraph to check your conclusions. Do your children agree that there is less friction in rolling objects than in sliding objects?

It takes energy to do work.
There is less friction in rolling objects.

Experimenting with Rollers. In case some of your children question the use of the broomsticks as rollers, it will be a fine opportunity to ask them to help get similar materials and try this experiment. Ask: "How can you show that what you say is true? How can you be sure?" Some children may be asked to show others how rollers reduce the sliding friction. Do your children reveal an attitude of being willing to experiment, thus giving evidence for their explanations?

If you are using rollers under the box, but children have difficulty in using them and in figuring out where to put the rollers, refer them to the second illustration on page 114. Ask: "Now where do you see the rollers (center and back)? Where is Mary putting a roller (front)? Who is pulling the box? Does anyone have to push the box now? Has the box moved more? Does it take more or fewer children to do the work of moving the box with the rollers?"

Read and discuss the last paragraph to clarify: that the rollers roll over the floor; that the heavy box does not rub the floor; that there is less friction with the rollers; and that it takes fewer children to move the box.

Explain that things which roll, such as balls and wheels, do not rub surfaces on which they are moving as much as flat objects. Help your children to see that we overcome friction by putting wheels on wagons, skates, and many toys. The children might arrange a bulletin board with pictures to show this. Could they write simple explanations for what they are showing?

Organizing Learning. Could someone make an illustrated sketch for a chart of a loaded box sliding over the floor. Write a caption. Show a box on rollers or wheels. Write an appropriate caption. Encourage children to give their own suggestions.

Brakes make things rub.
Brakes make things stop.

Page 115. Brakes Stop Things

Making Use of Friction. Ask your children if they have used a stick to help stop a wagon, as the boy is doing in the illustration. Could someone bring a wagon to school and show how a stick can become a brake? Ask: "What does the stick rub (wheels)? What does the wheel rub? What stops the wagon?" Discuss the fact that you make use of friction when you stop the wagon with the stick; that two rough surfaces rub together.

Reading About Brakes. Now read the first paragraph to see how the points of the discussion compare with this selection. Do your children understand the sequence of ideas in the text?

Help the children to note the car in the background. Discuss how brakes stop this car; that the brakes rub the wheels; that the wheels rub the ground; then the car stops; and that we make use of friction when we stop a car.

Could you observe the rough treads on tires with your children? Discuss the fact that there must be friction on the road; that a rough tread will prevent the tires from sliding so far when the brakes stop the wheels; and that tires with a good tread have move friction than old tires worn smooth.

Friction is useful.

Page 116. Friction Around You

Reviewing. Pages 116 and 117 are planned to aid you in helping your children to summarize or generalize about what they have been studying in this selection. Read the two questions at the bottom of page 116 with the children in order to help them know how to interpret the illustrations.

In the first illustration the wheel on the wheelbarrow makes less friction.

In the second illustration at the top of page 116 note that there is less friction because the ice is so smooth. Discuss that even on the smoothest ice no skates will slide for long unless the skater pushes or unless he is sliding downhill; and that the skater stops because there is friction between the runners and the ice. Explain that when an object presses on ice, some of the ice melts; that the runners on the skates press on the ice and melt it a little; that there is a little water under the runners; and that this helps to make the friction less.

Note that in the last illustration there is more friction in sliding (box) than in rolling friction.

Painting What You See. Use the questions on page 116 to help the children become more observant of the need for and use of friction around them. They

might wish to show on a large mural all the ways of using friction that they can discover. They might show their interpretation of such things as a driver placing blocks back of wheels on a truck, a workman putting sand on a road, a car with chains on the wheels moving over ice, children wearing rubber-soled shoes while playing on a gymnasium floor, holding a pencil, nuts on bolts, nails holding fast in wood, or any other situation where something is done to show the use of friction.

Page 117. Making Things Stop

Reviewing. Read the title and the question at the bottom of the page. Encourage the children to give their interpretation of the action in the pictures. Note that the boy on the bicycle uses its brakes; that the child on the scooter uses his foot against the ground as a brake; and that the rough tread on the tires, as well as the brakes, helps the truck to stop.

Explain that the brakes rub against the wheels; that the wheels rub hard against the ground; then the object stops; and that here the friction made by rubbing two rough surfaces together is useful. Encourage and help the children to relate and bring their own experiences and observations to this page in answering the question, "What makes these things stop?"

MATERIALS NEEDED

Materials suggested for use in Science Around You:

box (large wooden)
brakes (bicycle, wagon)
broomsticks (3)
rope (3' or 4')
rough materials (sandpaper, saw, wood, wool)
smooth materials (glass, ice, silk or cotton, tin plate)
stick (for brake)
wheels (bicycle, toys, wagon)
wood (for sawing)

Materials suggested for use in this Manual:

boards (wooden)
box
materials (buttons, coins, metal, woolen cloth)
paints (cold-water)
paper (about 4' × 15')
reading glasses
sandpaper
wheels (small toy car or wagon)
worn materials (chalk, clothing, shoes)

FURTHER EXPERIENCES

You might wish to provide extended experiences for accelerated children or all others. Provide time for them to share and demonstrate their findings to the other children.

Starting and Stopping Things. Energy must be used to start and stop objects. Push or pull a loaded wagon on a level surface. The children use their own energy to move the wagon. It is harder for them to start the wagon than it is to keep it moving. Help them to notice that the quicker they try to start it, the more energy is needed. They have to pull harder. Try to stop the wagon quickly. The quicker they stop and the faster it is moving, the harder it is to stop the wagon.

Stopping Quickly. Energy is needed to stop quickly. Encourage children to tell about their experiences running and stopping quickly. How do they feel? You might wish to draw a line on the floor. Suggest that a child run up to the line and try to stop suddenly. Does the upper part of his body continue to move forward although he may be able to stop his feet?

Talk with the children about sliding and coasting. Once they are moving, they tend to keep on moving; once they are at rest they tend to remain motionless. Inertia enables the children to coast and friction finally stops them. This tendency of moving objects to keep on moving and those at rest to remain still is called inertia.

Using Energy to Move Things. It takes energy to move things. Place a book over a sheet of paper. Pull gently on the paper. Note that the book goes along with the paper as long as you start the movement gently. Now jerk the paper quickly. It slides out from under the book.

Testing for Friction. Different kinds of materials can produce different amounts of friction. Collect many kinds of materials with rough and smooth surfaces. Classify the material according to rough or smooth surfaces. Test for friction.

Let children pull each other in a box. Push a box on the floor, rug, a paved sidewalk, or ice. Help the children to notice the difference in the energy required to push the box over different surfaces. There is more friction under some of these conditions. The children can easily determine this for themselves by experimenting. What is their interpretation of their experiments?

Decreasing Friction. There is less friction in rolling objects than in sliding objects. Push a loaded box along the floor. Then move the same loaded box in a child's express wagon. Encourage children to make their own explanations about friction here. Help them to become more adequate in the use of language to describe and interpret these experiences. There is much less rolling friction of the wagon than sliding friction of the loaded box. How do the children express their conclusions?

Fasten some rough sandpaper to a wooden board. Roll a small car over the rough sandpaper. Now try to slide a small object over the sandpaper. Where is there less friction? Where is there more friction? What interpretation do the children give of these experiences? Rolling

objects do not rub against the surface upon which they are rolling as much as flat objects do.

Observing Wear by Friction. Friction causes wear. Talk over with the children how rubbing causes clothes to wear out. Bring articles to school and show that where friction was greater there was more rubbing, on the soles of shoes, at the elbows of sweaters, and on collar and cuff bands of clothing. Rubbing weakens the fibers of materials and makes a hole. What is the attitude of the children toward the care of their clothing?

Observe wear by friction at school. Bits of chalk are worn off while writing on the blackboard. The lead (graphite) of a pencil wears off on paper while writing. Steps, stairs, and hallways are sometimes worn by many feet rubbing against the floor. Note how some of the worn-out materials become dust in the air.

Feeling Heat from Friction. Friction makes heat. Have children examine the skin of their hands under large reading glasses to see the rough places on them. When they rub their hands together hard, they become warm.

Rub a button, coin, or spoon against a woolen rug or coat. The metal becomes very warm due to friction. Why do we grease wagons, some toys, wheels, engines, and many other objects? The grease helps to make less friction where one part rubs another part of an object.

Perhaps a Boy Scout might demonstrate how to make a fire by rubbing sticks. It takes only a small amount of friction to light a match. But a smooth surface, such as glass or a waxed surface, rarely makes enough heat to light the match.

EVALUATION

Evaluation is continuously taking place where children and teachers really work together. There is usually some evaluation in planning because you make choices and decisions together. Are your children making progress in planning co-operatively with you? Do they need more opportunity to make choices and decisions with your guidance? If your children participate in planning their science experiences, you will no doubt see some growth along the following lines:

Planning helps children to state problems and hypotheses and not to depend upon guessing.

Planning helps children to check their thinking through experimentation and careful observation.

Planning helps children to read and evaluate reading material in order to verify their facts and opinions and to avoid gullibility.

Planning helps children to think through experiments, excursions, and other activities in such a way to insure safety.

Planning together tends to make for better relationships within a group because members take part in choices and decisions.

During the study of this selection, did you observe children interpreting their experiences rather than just describing them? Did they reveal growth in explaining conditions or giving reasons for what they believed to be true? As the children give interpretations, they have an opportunity to internalize what they see, hear, touch, taste, or smell. Thus there is greater depth in learning from their science experiences.

Did you see evidence that your children have improved ideas of the large pattern of energy, as: It takes more energy to move some things than others; rough things make more friction than smooth things; there is less friction in rolling objects than in sliding objects; and friction causes wear.

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Film

Friction. (YAF) 1 reel, b/w. Introduces the nature of friction as a restraining force in everyday life. Explains the ways in which we try to reduce friction and the ways we try to increase it when it is helpful.

Filmstrip

Friction at Work. (YAF) color.

X · MAKING THINGS MOVE

Children are curious about the movements of objects. They use their own energy to move about and to move objects. They use their own energy to touch and to grasp objects. They use their own muscular energy in pulling and pushing objects. They use their energy to do work in turning, dropping, lifting, or winding objects. They do work when the energy of their muscles enables them to move objects.

Children make use of mechanical energy when they fly kites, whirl pin wheels, or play with balloons. They may have watched the wind move the wheel of a windmill. They see the wind in the sails of boats. The wind does work when it moves objects. The wind is a source of energy for moving objects.

You know that children like to play with water. They like to splash it and watch things float or sink. They see water moving their little boats. You can help them to become articulate about water; that it is a source of energy for moving objects; that water does work when it moves objects.

Children wind with keys springs in many kinds of toys. They are curious, but not articulate, about what makes these toys move. Sometimes they have felt keen disappointment when springs in their toys failed to work. They may have wound the spring too tightly. They may be curious about springs and try to take a toy apart in order to see what makes it move.

Children can see that electricity moves things for them. They know that electricity does work. Children hear the whirl of motors in mechanical objects all around them at home, at school, and in the community.

Children have fire drills regularly at school. They learn to practice air-raid drills with considerable poise and calmness. In time they will learn more about atomic energy.

You can help children to become more articulate about their experiences in this area of energy and work. It is not enough for them to see, to feel, and to hear in their firsthand experiences. Adults must help children to become more adequate in coping with their environment by going beyond a firsthand experience. Children must have opportunities to talk things over with you, to ask questions of each other, to check observations and experimentation by reading, to see relationships between facts, and to make conclusions.

SCIENCE MEANINGS

The following science meanings will help you to develop some understanding of the large patterns of energy and work:

Energy can move things.
We know there is energy when we see things move.
People use their energy to move things.
They do work when they move things.
Springs make some things move.
Springs do work when they make things move.
Electricity moves things. Electricity does work.
The wind moves things. When it moves things, it does work.
Water moves things. Water does work when it moves things.
Steam moves things. Steam does work when it moves something.
Gasoline moves many machines.
Gasoline does work when it moves things.
We find energy in different forms: the wind, electricity, and others.

INFORMATION FOR THE TEACHER

People need energy to do work. The great source of the energy used on our earth is the sun. There are many forms of energy. People harness energy, transform it (change it from one form to another), and put it to work.

Forms of Energy. A body able to work possesses energy. We usually think of energy in the form of something moving or doing work. A lump of coal has potential ability to produce motion. This is called potential energy. The energy of actual motion is called kinetic energy. But an object does not have to be in motion to possess energy.

Heat Energy. In sawing wood the saw becomes warm. When you rub your hands, they become warm. A nail becomes warm when you pull it from wood. You know that when two substances are rubbed together, heat is produced. The amount of heat produced is in proportion to the amount of work done. Energy applied in rubbing is changed to heat. This heat is a form of energy. Fire also produces heat energy. Burning is a chemical action which produces heat and light. Both are forms of energy.

Muscular and Mechanical Energy. The energy of muscles is known as mechanical energy. This energy does work in the form of pushing, pulling, winding, lifting, dropping, or turning in some way. As you know, the energy of our muscles comes from the foods we eat.

Horses, llamas, camels, dogs, and oxen pull things for man. It is a form of muscular energy. The introduction of animals to work for man has helped greatly in building various civilizations.

Most machines do work by means of energy of a mechanical form. They do not create the energy but turn it into a useful form. For example, a gasoline engine can do work by using the energy from the burning gasoline. Many machines change the direction of energy. By pushing on the handle of a lawn mower, we cause the blades to whirl around. This round and round motion cuts the grass.

The Energy of Wind and of Falling Water. This energy is a kind of mechanical energy. The wind brings rain. The energy of wind helps to distribute water over the earth.

The energy of running water can be made to do work. Water does work by pushing the paddles of water wheels around. The old-fashioned mill wheel has developed into modern water turbines. With the development of electric generators, the water wheel may be used to turn a generator and produce electricity.

Electrical Energy. Electricity can be made to do work for us. Electricity can be changed to heat. It heats stoves and irons. It can produce light as in electric lamps. It can produce motion as in motors or bells. Other forms of energy can be changed into electricity.

Chemical Energy. Burning, a chemical change, releases heat. This is a form of energy. Chemical changes, as in batteries or dry cells, produce electrical energy. Energy which is released was stored in chemicals at some time in the past.

Atomic Energy. Children will hear much about atomic energy while they are using this book. Develop a feeling of confidence in the future with this new form of energy through its use for good. Even in connection with air-raid drills, children indicate poise and calmness. Keep in mind that man has had difficulties with each new form of energy, as in the breaking of a colt to work, the introduction of steam, and the industrial revolution.

WAYS OF WORKING WITH CHILDREN

Some form of energy makes things move.
We know there is energy when we see things move.

Page 118. Making Toys Move

Exhibiting Toys. There are many ways to start this work with your children. It may be within some everyday situation around you. You might wish to start with the illustration on page 118. Could you make use of your children's own toys and their observations? Perhaps they might wish to bring their toys to school. Arrange a space to exhibit them.

Stating Problems. During a discussion see if the children are aware of the source of energy that makes the toys move. If not, help them to state their problem. For example, "What makes different kinds of toys move?" Accept any level of the concept of energy and work for the time being but give the children an opportunity to grow.

Using Illustration and Reading. Turn to page 118 as a source of information to find out for sure. Help the children to read the title of the whole chapter and the title of the selection on page 118. This page may help the children to state problems. Talk about the toys in the picture. Ask about each toy: "What makes it move?" Read page 118.

Could your children group the toys in the illustration, as well as those in their own exhibit, according to the source of energy? The toys might be grouped with captions according to the source of energy required, such as: toys we push and pull; toys run by air or wind; toys run by electricity; toys we wind and others.

People use their energy to move things.
They do work when they move things.

Page 119. You Move Some Things

Interpreting Situations. Do you have a toy in your collection like Bill's on page 119? Note that Bill pushes the train; that it stops when Bill stops pushing. Read to check the children's comments. Discuss the fact that Bill does the work when he pushes; that he uses the muscles in his arms and legs to push. You may wish to take time to feel each other's muscles while pushing something.

Note what Bill is doing in the second illustration. Note that he pulls the wagon. Ask, "When does the wagon stop?" Read the second paragraph to find when the wagon stops. Discuss this sequence of ideas again: Bill is pulling the wagon; Bill uses the energy of his own muscles to do the work; and the wagon stops when Bill stops.

Guide the study of the last illustration by asking: "Who is working? What work is being done? What is moving?" Read the conclusions in the last paragraph on page 119. All the children should have an opportunity to demonstrate and to describe the source of energy, who is doing the work, and to generalize that moving things do work.

Springs make some things move.
Springs do work when they move things.

Page 120. Springs Move Some Things

Stating Hypotheses. Guide the study of the toys in the illustration. Ask: "What makes these toys move? Do we have toys in our collection that move like these?" Encourage the children to give their own explanations.

Children are usually not very articulate about springs doing work. If you listen, you will very likely hear children making hypotheses. They may not be accurate. They may make hypotheses, such as: The toy animals walk by magic; the child pushes the train in the picture to make it move; or others. Do your children notice the keys in the toys? Try some of your winding toys.

Refer to the train in the picture. What makes this train move? Does something in the train make it move? Encourage your children to make their own explanations.

Reading to Check Ideas. Whatever your hypotheses are, read page 120 to check the accuracy of your hypotheses. Are the children aware of your method for getting truth or solving your problems?

Experimenting with Springs. Could you take some old toys or old clocks apart and see the springs? Could you see a spring in different stages as in the illustration at the bottom of page 120? Do your children state generalizations in the conversation, such as: Springs move things; they do work when they move things.

Electricity moves things.
Electricity does work.

Page 121. What Makes the Train Move?

Interpreting Sources of Energy. You may wish to use a procedure similar to those for page 120. You will note the addition of tracks for this train in the illustration and in the text. You may wish to bring in the concept of friction here. If your children have previously used the chapter on "Friction," how well do they see the relationships between the smooth surfaces of wheels and tracks? If it is not too clear, you may wish to refer to the preceding chapter about friction.

The wind moves things.

Page 122. The Wind Moves Things

Interpreting the Illustration. You should be able to bring out in conversation all the ideas in the first paragraph. Ask: "What is moving the things in the pictures? Now who can read the title? What is the wind moving?" Here you see the drama of sudden changes in weather, such as: People are bending with the wind; it pushes Bill and turns his pin wheel; it blows dust, papers, trees, and clouds; white waves are on the lake; and a man's hat is blowing off. Can the children tell about their own experiences with wind (as a source of energy) moving objects?

Making Sailboats. Examine the second illustration on page 122. Check the comments of the children for accuracy by reading the last paragraph.

Perhaps you might wish the children to make their own sailboats. Watch for comments about friction as the construction work goes on.

If there is no body of water near you, you might help the children to secure a large container for water. Use an electric fan for the moving air to sail their boats. Safety precautions about the use of an electric fan in the classroom should precede its use.

When the wind moves things, it does work.

Page 123. The Wind at Work

Listening to Explanations. Do the children recognize the windmill? Do they know anything about its use long ago? How would a windmill help a farmer today? Do not hesitate to draw upon your own background about windmills. Tell children a few interesting facts about them. Has any child seen a windmill? Is there one near you that you could see working? Help the children to focus on the concepts of wind having energy to move things; when it moves things, it does work.

Use the children's questions or these to guide their reading: "How do farmers put wind to work? How do windmills do work?" Take time to let the children tell from their own experiences some answers to the question on page 123.

Water moves things.

Pages 124-125. Water Moves Things

Seeing Water Move Things. Encourage the children to tell about their experiences of seeing water move things. They may tell about boats and moving objects in the water, as paper, twigs, small rocks, and sand. Do the children notice the narrow and the wider part of the brook in the illustration on page 124? Which boat moves fast? Which boat moves slowly? Do your children disagree?

Read to see if their comments agree with those in this selection. Is there a brook near you where children might check their conclusions by observing their own boats moved by water.

On page 125 note the waterfall; that water seems to be moving fast; it moves over and around the rocks; it is strong enough to move things; and water does work when it moves things. Should all the facts not be developed, read page 125 for more facts.

Water does work when it moves things.

Page 126. Water at Work

Seeing the Force of Water. Help your children to get meanings from the illustration, such as: Here are a powerhouse, wires, a dam, and the force of water falling over the dam. Have the children seen a similar situation? Are they clear about the energy of the moving water? What does the water falling over the dam do? How does it help to make electricity? Help the children to see that the water turns big wheels around. Focus on the energy of the moving water to turn wheels.

Reading for Information. Does your discussion of water at work at a dam and powerhouse seem vague? Do the children sense a sequence in details? Are there differences of opinion? Can they give reasons for what they say? Ask, "How can we be sure?" Suggest that they read to find out what makes electricity. "How does electricity go from the powerhouse to other places?"

Help the children to answer the last two questions on page 126. Of course, children of this age would never go into a detailed study. It would be good if they could see a powerhouse and have a general idea of the large machines; that electricity comes through the wires from them. Look at the place where wires come into your building.

Electricity moves things.
It does work when it moves things.

Page 127. Electricity Moves Things

Observing Trains Move. Encourage the children to tell about their experience of watching trains. What kind of trains do they tell about? What source of power makes them move? Do the children see that electrical power or energy can make things move? What is the source of energy for trains near you? Could you visit a train to see for sure?

Study the illustration with the children. Ask, "How do you know electricity moves the train?" Help the children to see the overhead wires and the trolleys that touch the wires at the top.

Do the children see and discuss the smooth tracks and the big wheels? Ask, "How do the tracks help the train to go fast?" Discuss the fact that the tracks and wheels are very smooth; that the wheels make less friction. You may wish to reread appropriate selections from the preceding chapter on "Friction." However, the major focus here should be on electricity moving things; it does work when it moves things like this train.

Guide the reading by using the children's questions or your own comments or questions, such as: "Find two reasons why the train goes fast. How does electricity get to the train?"

Steam moves some things.
It does work when it moves things.

Page 128. Steam Moves Some Trains

Checking Interpretations. Through discussion find out if the children have seen engines like the one in the illustration. You might wish to ask, "What do you see in the illustration that makes you think this is a steam engine?" The children may bring out such facts as the fireman shoveling coal into the firebox; the tender's water tank receiving water; and the white cloud (it is not steam) escaping from the engine.

Help the children to read the title and the first paragraph to see if they brought out clearly all facts observable in the illustration.

Stating Problems and Hypotheses. Help the children to state the problem specifically, such as: What makes this engine move? Steam makes the engine move (hypothesis). Preparation for reading the second paragraph in answer to the problem may need further questions, such as: "Where is the water (engine)? What happens to the water (heated)? How does the boiling water change? How does the steam engine do work?"

Now check comments for accuracy by reading. The children should be able to follow and state in their own way the conclusions in the last two sentences.

Observing the Power of Steam. You should not count on all children understanding how strong steam is without some observation. Here is a simple experiment to help children check their verbal conclusion regarding the power of steam. Perhaps as a safety measure you might demonstrate this experiment and the children watch.

Boil water in a teakettle over a hot plate. Listen to the sounds of the boiling water. Soon it will be strong enough to push the top of the kettle about. Children could probably give further evidence about the power of steam from observing mother cooking at home.

Getting Firsthand Information. Perhaps you and your children might observe a steam engine at a railroad station near you. Note the coal or fuel oil which is used to heat the water. Does the engine's tender get water at your station? Can you see this activity? Can you see a fireman shoveling coal into a firebox? Do you see white clouds escaping from the engine?

Gasoline moves many machines.
Gasoline does work when it moves things.

Page 129. Gasoline Moves Things

Observing Machines. Go outdoors, if possible, to look for a variety of machines in your neighborhood. How many do you see that use gasoline as a source of power? What kind of work do the machines do? Do you see work being done which has another source of energy? What attitude do the children show toward machines?

Suggest that the children look at the illustration on this page. Ask, "What makes these machines move?" Most of these objects are machines that are within the everyday experiences of children. Encourage your children to apply what they have been learning, such as: Some source of energy or power is needed to move machines; machines do work when they move objects; machines do work for us.

Using a Bulletin Board Wisely. A bulletin board is a more fruitful learning opportunity if it calls for organization and grouping to show relationships. The children might write their own captions for groups of pictures, such as: "People Use Their Energy to Do Work," "Wind and Water Move Things," "Springs Move Things," "Electricity Does Work," or others.

Pages 130-131. What Makes These Things Move; What Makes These Machines Do Work?

You may wish to use pages 130 and 131 as one way of evaluating the progress of your children. In discussing "What Makes These Things Move?" you have four forms of energy illustrated. Can your children make use of their immediate past experiences? Do they understand the source of energy and the kind of work each source brings about? Do they state accurate conclusions in their own words for their level of maturity?

MATERIALS NEEDED

Materials suggested for use in Science Around You:

boats (toy)
electric train (simple)
sailboat materials (cloth, wood)
springs (from clocks or toys)
toys (push or pull, winding, electrical, sailing)

Materials suggested for use in this Manual:

bottle (pyrex nursing)
container (large)
cork stopper
electric fan
hot plate
kite materials (rags, paper, string, strips of wood)
teakettle
water wheel materials (spool, strips of tin or copper, tacks, wood for base, glass tube or dowel stick for axle)

FURTHER EXPERIENCES

Individual interests in making things move will vary among your children. Some children may need further experience to make concepts more meaningful. Some children may wish to go further with some of the following activities.

Making a Kite. Feel the force of wind and moving air on a kite. Kites may be constructed by fastening two light strips of wood in the form of a cross (24" and 18") and covering them with paper. The shorter strip should be bent like a bow by fastening a string to the ends. The kite string should

be fastened to the joint. A streamer of rags may have to be fastened to the bottom of the kite to secure stability.

When the children fly their kites, they will feel the pull on the string. The pull is caused by the force of the wind and moving air.

Making a Water Wheel. Show that the moving force of water can turn a water wheel. For this experiment you will need: a large spool; about five or six pieces of sheet copper or tin (tin can); small tacks; wood for a base; and a glass tube or a small dowel stick or pencil for the axle. For the construction of the water wheel the diagram on page 435 of Craig's Science for the Elementary-School Teacher will be helpful. Use the diagram to make the blades. Tack the blades to the spool. Put the axle through the spool. Attach the wheel to a wooden base as shown in the diagram.

Children may need help in assembling this water wheel. The value for the children is to hold the water wheel under a faucet so that the water strikes and moves the blades. This shows how a water wheel or very crude water turbine operates.

Observing the Work of Water. Running water does work. Perhaps you and your children can go outdoors during (if it is warm and children are dressed appropriately) or after a heavy rain. Note how many small streams of water are running downhill and carrying sand and mud. The swiftly moving water shows its power. Gullies are made by water carrying away materials. The running water moves soil. When water moves soil about, it does work.

Seeing Steam Do Work. Steam can do work. The teacher should demonstrate this experience to children as a safety measure rather than let them do it. Fill a nursing bottle (can be heated) about one-quarter full of water. Place a cork stopper in it loosely. Boil the water in the bottle. Avoid pointing the mouth of the bottle toward anyone as a safety precaution. As the water boils, steam is formed.

When there is not enough space in the bottle for all the steam, it pushes the cork out very forcibly. Hold the bottle in a safe direction. Steam has the force to move things. It does work, for example, when it pushes the cork out of the bottle or moves a steam engine.

Observing Various Mechanical Devices at School. If possible, take your children to the basement or elsewhere in your building to see various mechanical devices. Discuss safety measures before going on the trip. Ask the custodian or someone to go with you to tell the children what each device does. On the trip let the children see where the water enters and where waste water goes out of the building. Let the children see where electric wires come into the building, the location of the fuse box, or where gas enters the building. What attitudes do the children reveal toward the machinery? Are any of them fearful? Do they seem more interested in mechanical devices?

EVALUATION

Since individuals vary so much in background and experience in a given area, it is quite natural to expect variations in growth. As the teacher, you will have to be happy with whatever progress is made. A small amount of change in attitudes, behavior, or concept development for one individual might be extremely significant for him at that particular time.

Do you see growth in the ability of your children to make interpretations rather than merely describe events? Do they show a willingness to give reasons for their opinions? Do you see a difference in the attitude of the children toward machines? Is there more interest? Is there less fear of machinery? Do they make more things to test out their ideas? Do the children have improved ideas about energy in different forms, such as the wind, water, electricity, and others? If you see changes along these lines, you may be sure that they are making significant progress.

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For the Children

Elting, Mary. Machines at Work. Garden City Publishing Company, 1953. Children will enjoy selected excerpts and pictures about many kinds of machines that dig, hammer, and push.

Elting, Mary. Trains at Work. Garden City Publishing Company, 1953. Pictures and selections about different kinds of trains and workers may be used.

Keelor, Katherine L. Working with Electricity. The Macmillan Company, 1951. Selections about lights, bells, and messages may be used with the children.

Schneider, Herman and Nina. More Power to You. William R. Scott, Inc., 1953. Excerpts may be read to the children to show what makes many things move. The book will be more useful to the teacher.

Film

What Are Machines? (IF) 1 reel, b/w. Vividly defines what a machine is, how machines were developed, and how machines have changed our way of living.

XI · CARE OF THE FARM

The problems in the area of conservation are so acute that it will take years of education to prevent the misuse of our natural resources and other materials. Our youngest citizens should begin to develop some sensitivity to these situations. You should keep in mind that conservation should mean intelligent utilization of resources.

A child is fortunate who has some adult, either in his home or school, who will walk with him into the out-of-doors and open up new avenues of thought. In this chapter you will follow Jim and his father over the fields, into the woods, and to the brook on their farm. Their conversations reveal desirable attitudes in the care of soil, animals, woods, wildlife, and machines on their farm. Here is an adult giving explanations and interpretations to a child. You can help your children to use and care for materials wisely.

In Science Around You the authors have tried to reveal a wise use of the out-of-doors. On page 13 children picked leaves from the ground instead of taking them from the tree. On page 14 they left the leaf buds outdoors. On page 15 they left seeds outdoors because the meadow will need the seeds next spring. On page 19 the butterfly chrysalis was left outdoors because the schoolroom was too warm and the butterfly might come out before the cold winter was over.

You noticed that the terrarium on page 31 is stocked with common but plentiful plants rather than with rare or scarce ones.

On page 100 your children may have read that Mary brought a turtle to school. Here the children tried to make a place for the turtle to stay as much like its outdoor place as possible. After a day or two they took it back outdoors because "the big woods is a good place for the turtle."

You observed that Mary, on page 108, left plants to grow outdoors where there were only a few. However, where there were many, she did take a few plants to school for study.

On page 141 you will find that Jim's father plants young trees as he cuts down the mature trees.

These are good practices for the care of natural resources. Children may see or participate in them. From such actions you may expect to find desirable behavior developing toward the care of many things.

SCIENCE MEANINGS

The following science meanings will help you to develop some understanding of the large science patterns or principles, such as interrelation-

ships, balance and variety, energy and work, and adaptations made by living things:

Soil needs care. Plants help to hold the soil.
Horses help to do work. They need care.
Tractors help to do work. They need care.
Iron will rust when wet.
The woods make a good home for some animals.
Trees and leaves help to hold the soil.
Young trees should be planted when trees are cut.
Our country needs good farm land.

INFORMATION FOR THE TEACHER

It is important to see the relationship of living things to their physical environment. Wise use of our resources calls for a study of the principles involved in the struggle for existence, the balance of nature, and the interrelationships of life.

Soil: A Natural Resource of a Community

Kinds of Soil. Usually there is a wide variety of soils in a given community. Several factors influence the formation of soil. Different kinds of rock help to make a variety of soil. The same kind of rock may produce many kinds of soil in different climates. Plants influence the soil, too. The soil determines the kind of vegetation found in a given place.

When sandstone is the beginning rock, sandy soil is the result. However, the fertility of this type of soil may be increased by the addition of organic materials.

Clay soil, on the other hand, is frequently more fertile because it is made from igneous rock, which usually contains more chemical elements. Many plants do not grow well in clay soil, however. When it is dry, the soil becomes hard and baked.

The best type of soil for agricultural purposes is loam, which is a mixture of sand and clay. Sandy loam is easier to prepare for planting and easier to work after seedlings have developed. What kind of soil do you have around you? What is the story of soil you have around you?

Soil Erosion. Soil erosion is a process that has been going on since the earth first had atmosphere. Erosion works on the surface of the earth. In a long-time view of the earth, erosion has been beneficial for much of the surface of the earth. Erosion may have prevented large areas of flatlands or water-soaked plains. Erosion has been most harmful where man has removed protective coverings.

In some regions the soil blows easily. Often the soil is powdery and when it is disturbed, it blows. Little whirlwinds, dents, and ripples can be

seen. It is well for all to remember that water is largely responsible for erosion in some areas. In most places both wind and water are responsible for erosion.

Forest: A Natural Resource of a Community

Forest Lands. Forest lands are developed by modern farmers. More and more farmers and lumbermen have a planned way for cutting and replanting trees. Do you see this practice around you? It is a well-known fact that soil will wash away when trees are removed and the land is left bare. An accumulation of soil through centuries of soil formation can wash away in a matter of weeks.

What story do the forests around you tell? Has the damage often done by early settlers been overcome? Do forests contribute to the soil and water resources around you? Is the wildlife protected in your areas?

Windbreaks. Windbreaks have long been used around farmhouses in the prairie region. The government has been concerned with building a shelter belt from North Dakota near the Canadian border through the Great Plains and on into Texas. Do you see windbreaks and shelter belts near you? What kind of trees are used? Do they furnish protected places for wildlife? Would a windbreak near your school be advisable?

Water: A Natural Resource

Water for Plants and Animals. Plants and animals vary in the amount of water they need but they must have water to exist. The amount and availability of water has a great effect upon the distribution of plants and animals.

Plants and animals found in a dense, moist woods differ from those at the edge of open woods and fields. Living things in a valley may differ from those at the top of a dry sunny hill. Life in a marsh or swamp differs from pond life. Desert life is still another story of water and the adaptations of living things.

Wildlife: A Resource of the Community

Importance of Wildlife. In general, wildlife has suffered and has been neglected. People are unaware of the many values that come from this vital resource. The fertility of the soil is greatly enhanced by plants and even the lowly earthworm. Birds help to keep insects in check. Skunks, hawks, snakes, and other animals help to keep rats, mice, and insects in balance.

Birds, deer, and other animals often lose their homes when forests are cut down. When swamps are drained, we lose animals because they lose their natural homes. Some animals that seem insignificant to us may help to maintain a balance of nature favorable to man.

What kinds of wildlife do you find in your community? Is a balance in wildlife maintained in your region? What is being done to prevent unwise use of wildlife?

Each kind of plant life has its own kind of animal life. Some of this plant and animal life might rightfully be considered pests. But we need to be better informed about the value of both plants and animals. Even weeds have considerable value in certain places. They help to cover soil of new road grades, untilled fields, and sites where natural vegetation has been removed. Weeds may be the first or pioneer plants to grow in a disturbed area. Later other kinds of vegetation, such as pine trees, may dominate.

WAYS OF WORKING WITH CHILDREN

Soil needs care.
Plants help to hold the soil.

Pages 132-133. Soil Needs Care

Examining Soil. Encourage your children to discuss why the plants in the picture seem to be growing well. Discuss conditions that help plants, such as rich soil, good drainage, warmth, and light. The children might compare how the soil looks in the picture with the soil around them. Do plants grow well near the school, in home gardens, or on farm lands? Is the soil sandy, rocky, or rich?

In studying soil around you, you will wish to avoid embarrassing those children who come from places having poor soil. It is well to remember that wherever one may look, the soil will be different from that in other places.

Another way to begin this study might be through your need for some good soil for indoor gardens, for flowerpots, tree boxes, or for flower borders or rock gardens on the school ground.

You might wish to help your children to plan and study along the following lines: What kinds of soil do we need? How many kinds of soil might we bring to school? Which is the best for our use? What makes good soil? What does good soil have in it? How does it look? How does it feel or smell?

You may wish to examine under a reading glass soil from a variety of places. Label soil from such places as these: near a swamp, a hillside, the deep woods, the outer edge of the woods, a meadow, a cornfield, a garden, under a decaying log, or the bank of a brook. Notice variations in the soil, such as the color and texture, living things in it, the amount of moisture, whether it is packed or loose, its smell, and whether it contains bits of rocks, leaves, or stems.

Reading About Soil. On page 133 help your children to see that Jim and his father are examining the soil. Ask: "What do you think they are saying

about the soil? Is it fine or coarse soil? Is it good soil? Does water move the soil away? How does good soil feel when you rub it between your fingers? How do plants help soil?"

Check the children's thinking by guiding their reading on page 133. You may wish to help the children see and tell how plants hold soil. Could you take a walk outdoors with your children to see where plants help to hold soil around them?

Horses help to do work.
They need care.

Page 134. Horses Need Care

Visiting a Farm. Perhaps you live where you could go to a farm to see how the farmer uses and cares for his horses, tractors, or other machines. Try to see the kinds of work that the horses do. You would, of course, see variations in different seasons.

Other firsthand experiences the children might have at the farm are: Seeing woods used by animals and their young; seeing trees and other plants that help to keep the soil from washing away; and observing how leaves help and how young trees grow. You might prefer to arrange more than one trip in order that the children's purposes and experiences may be more limited. The children may reveal their interpretations by painting pictures.

Checking Hypotheses. You might help your children to state what they expect to see during their visit to the farm. What care do they expect to see horses having? What work do they expect to see horses doing? You help the children to state hypotheses when you help them to state what they expect to see. As the children observe in firsthand experiences, help them to check or verify their hypotheses. Check your hypotheses also by reading page 134.

Tractors help to do work.
They need care.

Page 135. Tractors Need Care

Caring for Machines. Have your children seen a machine like the tractor in the illustration? What kind of work have they seen tractors do? Do they know that iron is used in making tractors; that things made of iron may rust when wet? What machines and tools can the children see around school? How are they cared for?

Note the sky conditions in the illustration. What kind of weather seems likely to occur? Why is Jim's father driving the tractor into the barn? Could the children tell of similar experiences? Read the first paragraph to see if the children's ideas are in agreement with this selection.

Iron will rust when wet.

Experimenting with Rust. After your children read the last sentence in the first paragraph, you might guide their attention to the small illustration in the right margin. What do they expect will happen to the nails? What does rust look like? How long does it take for rust to form? How can the children be sure? Read the first two lines in the second paragraph to check steps in the experiment. This procedure is only suggestive.

Such a procedure as stating hypotheses, experimenting to test hypotheses, and checking observations by reading will help the children to make use of the scientific method. They need guidance step by step in this kind of discussion and reading.

Interpreting What You See. The second illustration has materials needed for an experiment to show rust forming on nails. What explanation for rusting do your children offer? Help them to try this experiment. How do your children interpret the experiment? How long does it take for rust to appear? What is the color of rust flakes? Can you use the nails easily after rust appears?

Giving Explanations. Use the question at the bottom of page 135. Do the children tell how they have seen rust prevention on things made of iron? Look around the school for rusted objects and objects which have been painted or oiled to prevent rusting. Encourage the children to look at home, too. To prevent rust keep objects clean, dry, and sometimes oiled. Garden tools may be cleaned and rust prevented by dipping them in a container of sand mixed well with oil.

The woods make a good home for some animals.

Pages 136-137. A Home for Animals

Seeing Animals in Natural Habitats. Do the children see that the animals in the picture are in their natural habitats? Do they notice the young with the animals? Why do some of these spots make good homes for the animals and their young? Can the children tell of times when and places where they have seen some of these animals? Can they tell about other animals that live in woods near them?

Guiding Reading. In such a discussion do some members of the group disagree with one another? Do they give reasons for their beliefs and opinions? Are they willing to read pages 136 and 137 to see if there are facts which support their ideas? Children's questions, conflicting points, or your own questions can become purposes for guiding their first reading.

Trees help to hold soil.

Page 138. The Woods Help

Discussion and Reading. Help your children to focus their conversation on the woods at the top of the hill as they study the illustration. Ask: "Where are the woods in the illustration? What do you think Jim and his father are saying about their woods? How do you think the woods help their farm? Does the soil wash away?" Guide the reading from comments or questions.

Could you visit a wooded spot near you? Could you see how the trees prevent the soil from washing away? Who cares for the wooded area? Was your region heavily wooded when it belonged to the Indians?

Unless the value of trees is developed with children, they are likely to take trees around them for granted. Trees may have been there when they were born. Children do not always realize that trees are plants; that trees are alive and growing just as they themselves are living and growing.

Organizing Learning. After discussion your children might wish to make a chart showing the value of woods. Your children may think of values other than the following: Forests supply us with wood to burn; wood is used for buildings; trees give us fruits and nuts; woods make a good place for picnics and hikes; they make the landscape beautiful; woods make a home for some animals; and trees and other plants help to hold the soil. They might make large pictures of these or other ideas.

Recording Observations. If possible, walk through a woods or a park or look at trees on your school grounds to see how the roots hold the soil. Record the facts that you observe for an experience reading chart. The children should help compose the sentences for this record. They may prefer to make a picture record of this experience.

Leaves help to hold the soil.

Pages 139-140. The Leaves Help

Making Interpretations. You may wish to help the children note the cover of leaves on the ground in the illustration. Contrast the old, dark leaves you see here with the brightly colored leaves that have just fallen from the trees in the chapter on "Autumn." Ask, "How would you expect the leaves to look and feel?" You might wish to record these hypotheses.

Could you help the children to be sure about their hypotheses, by going outdoors to a spot where leaves cover the ground? What color are the leaves on top? Contrast the leaves on top with those beneath. How does the soil feel under the leaves?

The children might look under the leaves to see that they keep the soil from drying out and that it does not wash away. Plants can grow because of

this moisture. Cover the ground again to keep the soil from washing away. Now you might read to see how your conclusions check with page 139.

Leaves help some plants to live through the winter.

Discussion and Reading. On page 140 note in the illustration how leaves seem dry and are breaking up. What words do your children use to describe this process? Discuss how this would help plants. Observe this decaying process near you. Examine this decaying process of leaves under a reading glass. Do decayed leaves protect plants near you?

Those children who live in places where it snows in winter or early spring might look for plants whose roots have lived under snow. Then watch these particular plants as spring comes.

Compare the explanations your children give with the facts on page 140. Do your children accept these facts?

Young trees should be planted when trees are cut.

Page 141. Young Trees Grow

Planting Young Trees. Help your children to focus on the young trees in the illustration. What do you think Jim and his father are discussing? What clues do you see in the illustration? Help your children to see: Jim standing near a young tree about his height; that many little pines and other trees are growing; the stump of a tree that has been cut; and that the trees are a part of the farm.

Discussion and Reading. Help the children to question how the young trees got there. There may be a difference of opinion. Now read page 141 to find out for sure.

Does this practice of planting young trees go on around you? Do you see places where young trees might be planted? Do you need to plant young trees on your school grounds? Do you know farmers who plant young trees when they cut the old ones?

Our country needs good farm land.

Page 142. Soil Helps the Farm

Reading and Discussion. Encourage your children to express their ideas as to why this might be a farm with good soil. Their ideas might be: Plants are growing; it does not look rocky; the color of the soil is good; and the soil probably does not wash away.

Children who live on farms might compare the soil on Jim's farm with the soil around them. Help the children to feel a pride in farm lands; to see how important it is for their country to have good soil and good farm lands; and to understand that the farmers help many people.

Page 143. Watching Plants and Soil

Reviewing. You may wish to use page 143 for review purposes and for making conclusions.

MATERIALS NEEDED

Materials suggested for use in Science Around You:

glass (for water)
nails (iron)
reading glasses

Materials suggested for use in this Manual:

containers (for plants)
containers (for soil)
rocks (small)
seed (grass)
seedlings (tree)
soil (different kinds)

FURTHER EXPERIENCES

You may wish to provide for your children further opportunities than those suggested in this chapter of Science Around You.

Seeing How Leaves Help. See how trees or other plants help to keep the soil from washing away. If it is warm, take the children to a park or woods while it is raining. See how the leaves on the ground act as a sponge and prevent water from running off. Have the children study the leaf mold. Make sure they leave the woods in as good a condition as it was when they came.

At the same time you might take the children to a place where there are no leaves on the ground so they may see how, if there is no cover, the water runs along rapidly, carrying soil with it. Trees and other plants help to keep the soil from washing away.

Seeing Some Value in Weeds. See how weeds have value in many places. Take a walk over the school grounds, a park, or a field. Look to see where weeds are actually helping to hold the soil. What would happen if they were removed? Discuss the advisability of making a plan to care for a spot before removing the weeds.

Preventing Soil from Washing Away. Plant young trees to prevent soil from washing away.

If possible, take a walk in a wooded area to see various stages in growth of trees, from a tiny seedling to a tree with a few years' growth and finally to a tree of full maturity. Encourage your children to tell of places where young trees are planted or allowed to grow.

Try to see a natural spot showing the succession of plants, such as weeds, larger grasses, seedlings, and finally where mature trees dominate plant life.

Could you plant some young trees on your school grounds? What kind of a place do your trees need? Will they need much water? How long do you think it will take them to grow up? How much do you expect them to grow each year? Many local and state agencies provide young trees for people who wish to plant them. Do you have such an agency near you?

Experimenting. See how grass helps to keep soil from washing away. The children might place a mound of soil in a container. Place a few rocks on the bottom to help the drainage. Then plant grass seed. If kept damp for a few days, the grass will sprout. After the grass has established a good root growth, pour water over the mound to show how a cover of plants will help to keep the soil from being washed away.

At the same time there might be a mound without any grass on it. When water is poured on this, the soil washes away, making gullies.

Finding Living Things in Soil. See how good soil may have living things in it. Try to secure a few little plots of soil about five or six inches square. The plots should be of about the same depth. Try to get soil from a variety of places. Examine the soil plots with reading glasses. You may see that plots from different places have different living things in them.

In one sample remove all living things. Place these in a warm place and keep moist for a few days. Although these things seemed to be not alive in the soil, you may see that insect eggs and seeds of plants will start developing. As living matter decays, it helps to enrich the soil.

Before the children remove the plots of soil, discuss the need of preventing soil erosion by placing rocks, leaves, or other matter in the place from which they take their soil. Leave the ground in as good condition or better than you found it.

EVALUATION

This chapter has suggested ways of developing several elements of the scientific method as discussed on page 6. As your children engage in these experiences, note their patterns of behavior along the following lines: Do you see individuals sensing and stating problems or questions? Do individuals now state their own hypotheses? Do they suggest ways of testing hypotheses (by experimenting, observing, or reading)? Do they state conclusions? Are they willing to check conclusions by reading authentic materials, by further observation, or experimentation? You should not expect the same amount of progress from every child. A little change in one individual may be very significant.

Try to think of conservation as a kind of good behavior. Do your children feel a responsibility for the environment? What is the children's attitude

about removing things from the out-of-doors? How do they care for their own clothing? Do they waste food?

Are they wasteful of paper, pencils, or other materials? Do they destroy materials? Do they throw papers about while on an instructional trip? Do they care for tools and equipment? It is through watching behavior that one can tell whether or not the child is really learning wise use of the environment. It is most important that boys and girls develop behavior that is a sound basis for conservation.

BIBLIOGRAPHY

For the Teacher

Craig, Gerald S. Science for the Elementary-School Teacher, pp. 114-129. Ginn and Company, 1947.

Osborn, Fairfield. Our Plundered Planet. Little, Brown and Company, 1948.

For the Children

Parker, Bertha M. Saving Our Wild Life. Row, Peterson and Company, 1944. Selections may be read and discussed with children about the wise use of plant and animal life.

Smith, F. C. The First Book of Conservation. Franklin Watts, Inc., 1954. About interrelationships of water, forests, wildlife, plants, and soil and ways in which man is conserving natural resources.

Films

Our Animal Neighbors. (Cor) 1 reel, b/w and color. Some common animals shown are the gray squirrel, cottontail rabbit, gopher, deer, meadow mouse, mule, and bat.

What Is Soil? (IF) 1 reel, b/w. Shows that soil is essential to all living things and that they in turn contribute to the formation of soil.

Wonders in Your Own Backyard. (C-W) 1 reel, b/w and color. A boy and girl find a worm, spider, millepede, sow bug, and snail. Film reveals some of the conditions under which they live.

Filmstrip

Conservation for Beginners. (SVE) 6 color.

APPENDIX

MATERIALS NEEDED FOR SCIENCE AROUND YOU

These materials may be secured within the school, from the home, or at local stores in your community.

Aquarium with cover
Balls
Bell (electric)
Bottle (pyrex nursing)
Bottle (quart)
Box (wooden)
Broomsticks
Bulbs (onion or narcissus)
Cages (for animals)
Candles
Clock
Cloth (making shadows)
Cloth (scraps of silk, wool)
Dishes (deep, shallow pyrex)
Dry cells (1 or 2)
Electric hot plate
Flashlight
Flowerpots (porous)
Glass (4" × 6")
Glasses (water)
Globe (earth)
Kites
Nails
Paints (cold-water)
Pan (shallow)
Paper (for painting)
Pin wheels
Pitcher (glass)
Push button
Reading glasses
Sailboat (toy)
Sandpaper
Saw
Screened box
Seeds (bean, radish, Lima-bean)
Spoon (tablespoon)
Springs
String
Switch (knife or push button)
Teakettle
Thermometer
Tin cup
Toys (winding, wheeled)
Wire (insulated copper, #22 recommended)

PUBLISHERS' DIRECTORY

Aladdin Books (American Book Company), 55 Fifth Avenue, New York 3, New York.
Wm. C. Brown and Company, Dubuque, Iowa.
Doubleday and Company, Inc., Garden City, New York.
The Dryden Press, 31 West 54th Street, New York 19, New York.
Garden City Publishing Company, Inc., Garden City, New York.
Ginn and Company, Statler Building, Boston 17, Massachusetts.
Harcourt, Brace and Company, 383 Madison Avenue, New York 17, New York.
Harper and Brothers, 49 East 33rd Street, New York 16, New York.
Little, Brown and Company, 34 Beacon Street, Boston, Massachusetts
David McKay Company, 606-608 South Washington Square, Philadelphia 6, Pennsylvania.
The Macmillan Company, 60 Fifth Avenue, New York 11, New York.
William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, New York.
Oxford University Press, 114 Fifth Avenue, New York 11, New York.
Row, Peterson and Company, 1911 Ridge Avenue, Evanston, Illinois.
William R. Scott, Inc., 8 West 13th Street, New York 11, New York.
Franklin Watts, Inc., 699 Madison Avenue, New York 21, New York.

FILM AND FILMSTRIP DISTRIBUTORS

A1F	Almanac Films, Inc., 516 Fifth Avenue, New York 18, New York.
CurrF	Curriculum Films, Inc. Distributed by Educational Projections, Inc., 10 East 40th Street, New York 16, New York.
C-W	Churchill-Wexler Film Productions, 801 North Seward Street, Los Angeles 38, California.
Cor	Coronet Films, Coronet Building, Chicago 1, Illinois.
Cornell	Cornell Film Company, 1501 Broadway, New York 36, New York.
EBF	Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois.
IF	Instructional Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois.
SVE	Society for Visual Education, Inc., 1345 West Diversey Parkway, Chicago 14, Illinois.
YAF	Young America Films, Inc., 18 East 41st Street, New York 17, New York.

NATIONAL FILM RENTAL AGENCIES

A. F. Films, Inc., 1600 Broadway, New York 19, New York.

Association Films, Inc., 347 Madison Avenue, New York 17, New York; Broad at Elm, Ridgefield, New Jersey; 79 East Adams Street, Chicago 3, Illinois; 351 Turk Street, San Francisco 2, California; 1915 Live Oak Street, Dallas, Texas.

Brandon Films, Inc., 200 West 57th Street, New York 19, New York.

The Bray Studios, Inc., 729 Seventh Avenue, New York 19, New York.

Contemporary Films, Inc., 13 East 37th Street, New York 16, New York.

Ideal Pictures Corporation, 211½ Murray Street, Alexandria, Louisiana; 52 Auburn Avenue, N.E., Atlanta 3, Georgia; 537 North Howard Street, Baltimore 1, Maryland; 40 Melrose Street, Boston 16, Massachusetts; 1558 Main Street, Buffalo 8, New York; 58 East South Water Street, Chicago 1, Illinois; 125 East Sixth Street, Cincinnati 2, Ohio; 2010 North Lamar Street, Dallas, Texas; 714 18th Street, Denver 2, Colorado; 2109 Forest Avenue, Box 1130, Des Moines, Iowa; 7338 Woodward Avenue, Room 407, Detroit 2, Michigan; 1370 South Beretania Street, Honolulu, Hawaii; 1402 Locust Street, Kansas City 6, Missouri; 8826 Olympic Boulevard, Beverley Hills, California; 422 West Liberty Street, Louisville 2, Kentucky; 23 North Mulberry, Mansfield, Ohio; 18 South Third Street, Memphis 3, Tennessee; 1331 North Miami, Miami 32, Florida; 1915 Chicago Avenue, Minneapolis 4, Minnesota; 233-239 West 42nd Street, New York 36, New York; 4247 Piedmont Avenue, Oakland 11, California; 704 North Broadway, Oklahoma City, Oklahoma; 1729 Sansom Street, Philadelphia 3, Pennsylvania; 915 S. W. 10th Street, Portland 5, Oregon; 219 East Main Street, Richmond 19, Virginia; 54 Orpheum Avenue, Salt Lake City, Utah.

Instructional Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois; 101 Marietta Street, Atlanta 3, Georgia; 5745 Crabtree Road, Birmingham, Michigan; 161 Massachusetts Avenue, Boston 16, Massachusetts; 1414 Dragon Street, Dallas 2, Texas; 5625 Hollywood Boulevard, Hollywood 28, California; 202 East 44th Street, New York 18, New York; 2129 N. E. Broadway, Portland 5, Oregon; Post Office Box 358, Wilmette, Illinois.

International Film Bureau, Inc., 57 East Jackson Boulevard, Chicago 4, Illinois.

Nu-Art Films, Inc, 112 West 48th Street, New York 19, New York.

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